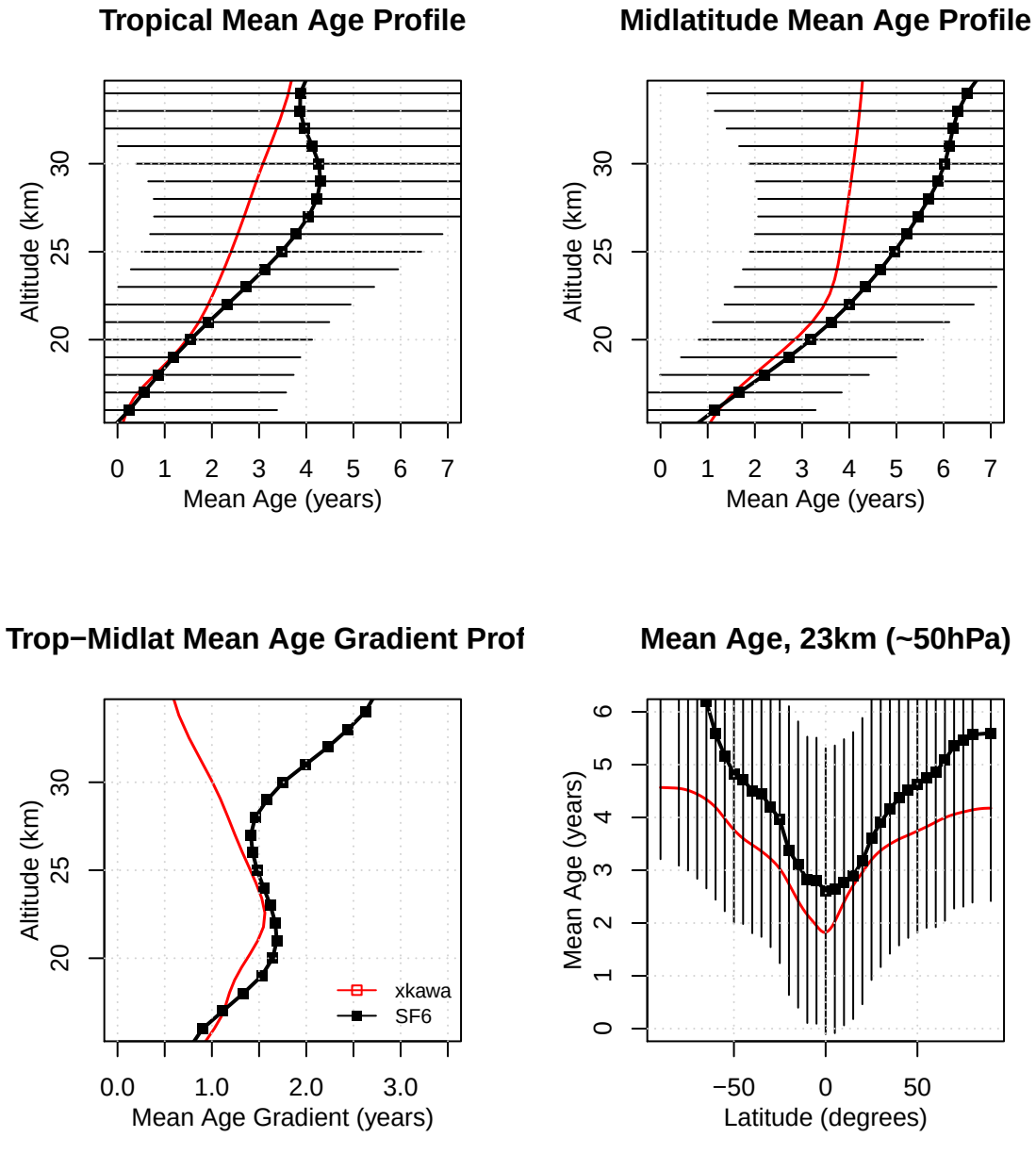
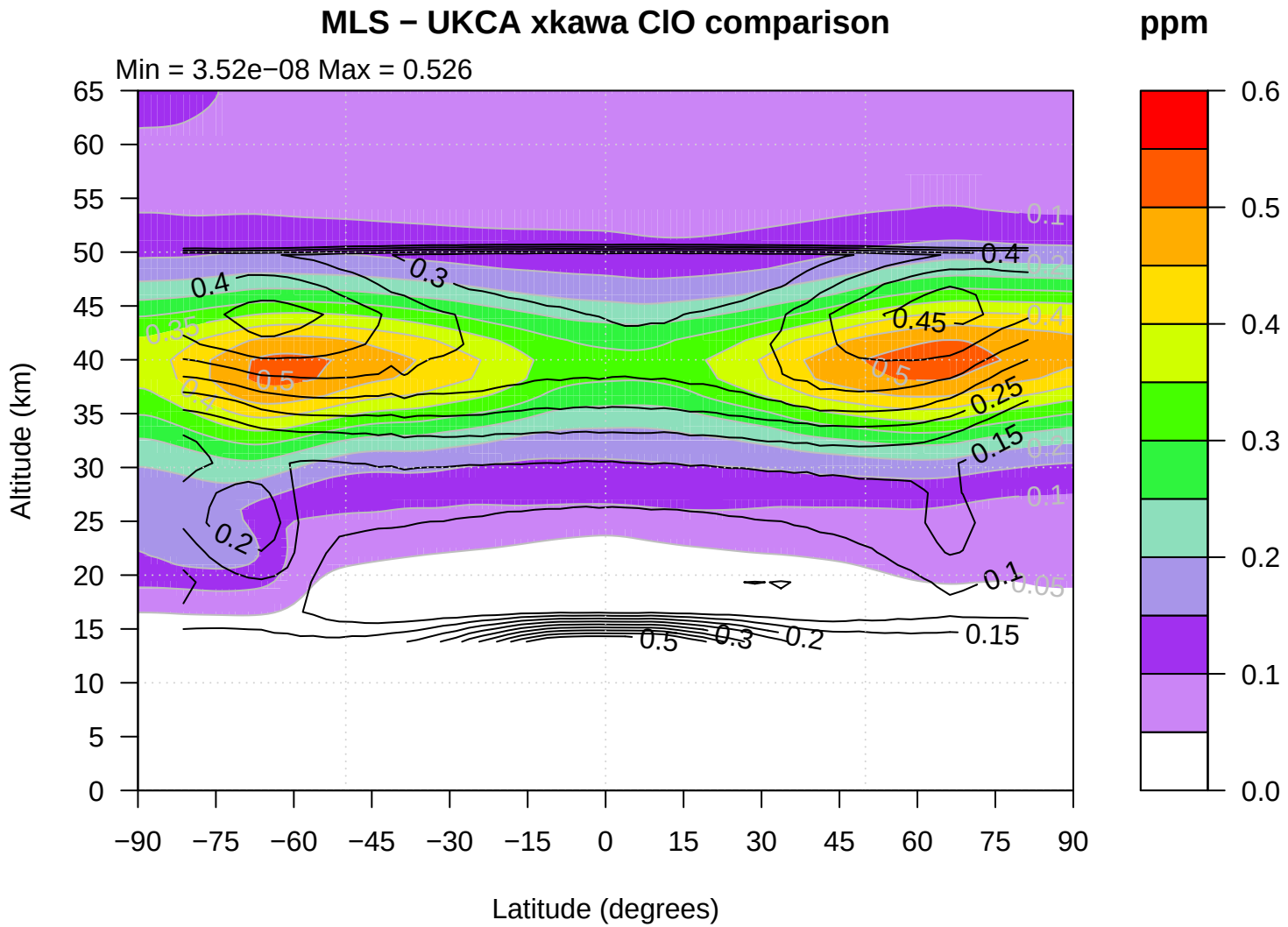
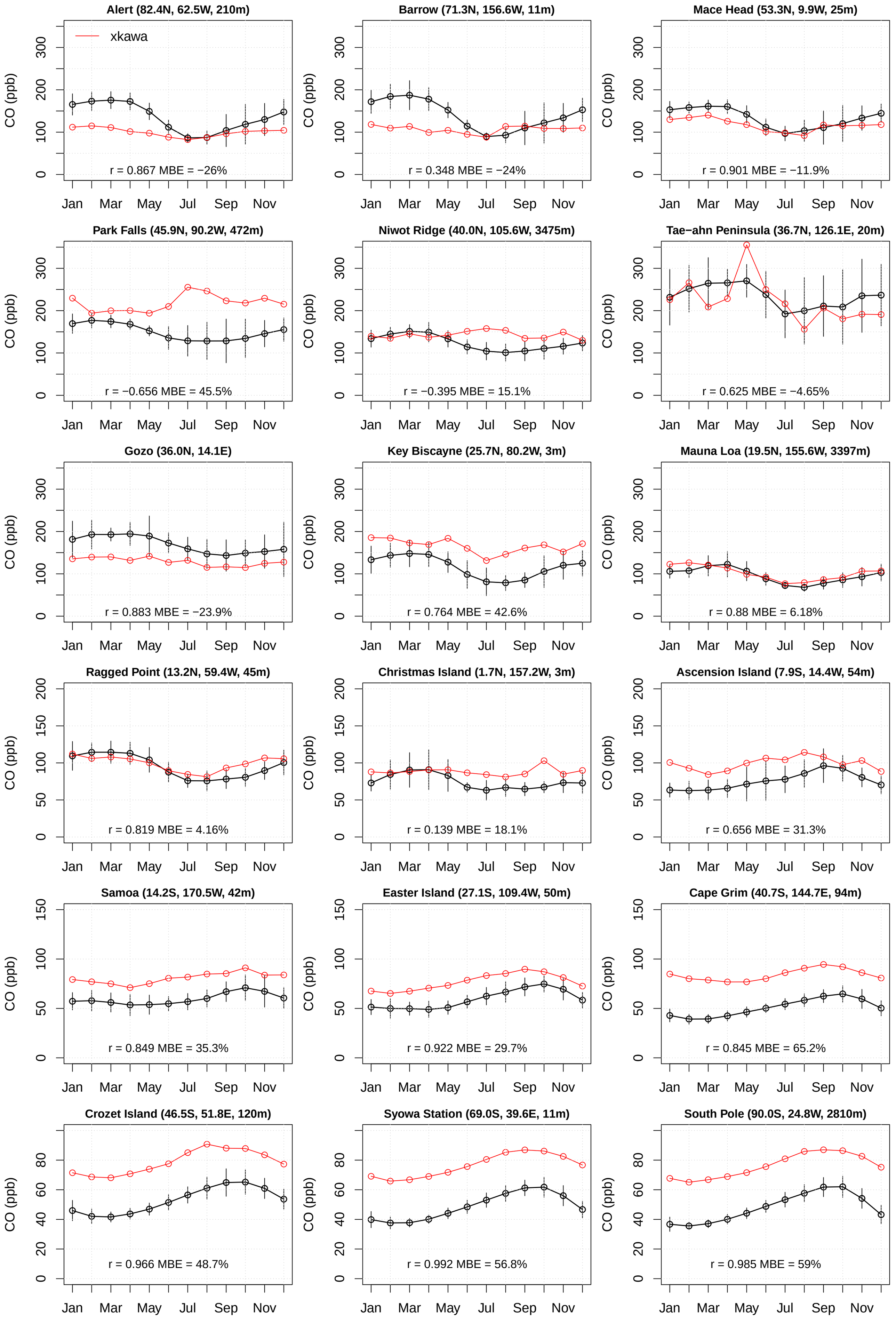
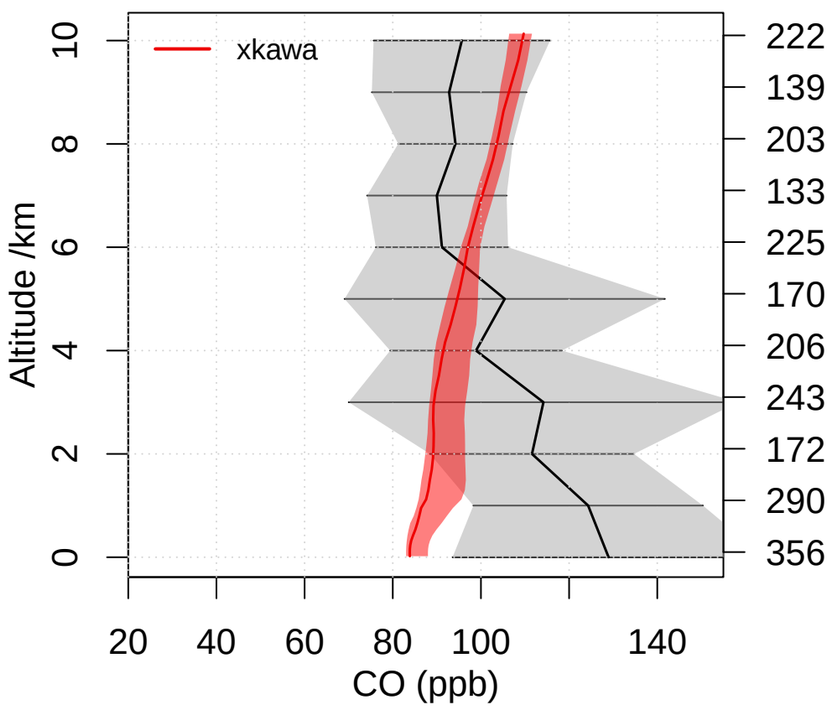
# UKCA xkawa Mean Age of Air

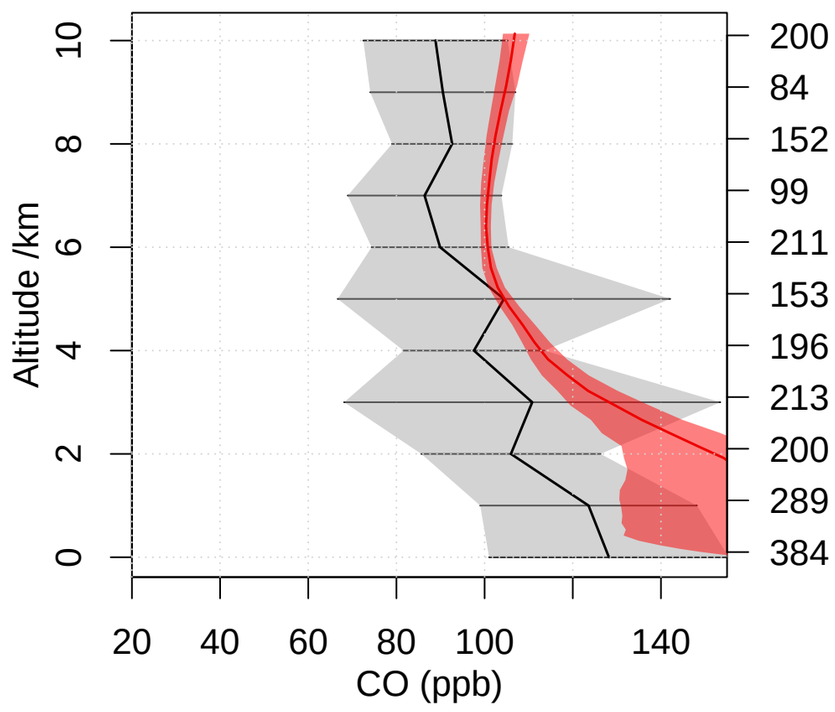


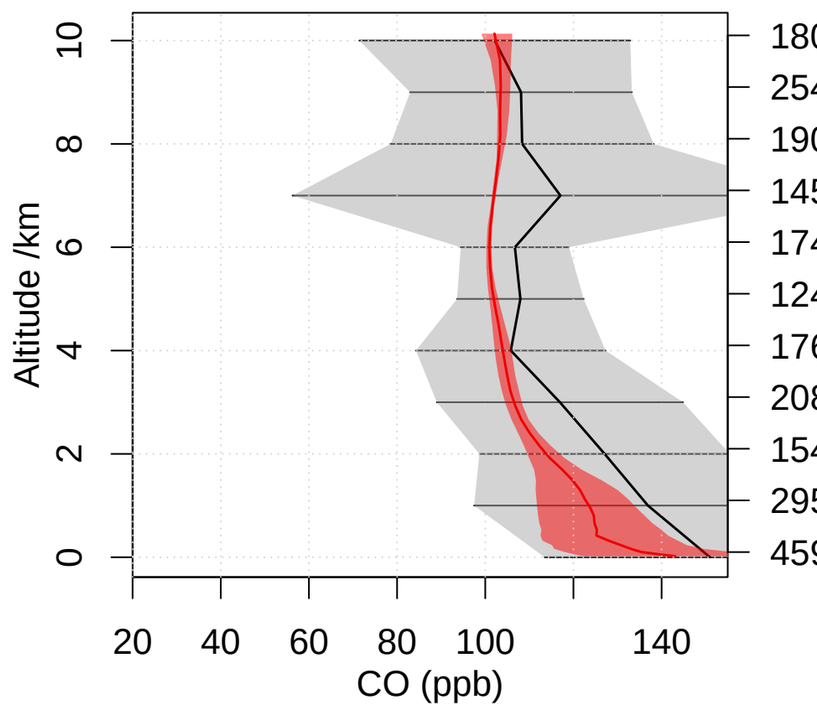

MLS − UKCA xkawa ClO comparison
ppm
Min = 3.52e−08 Max = 0.526
Altitude (km)
Latitude (degrees)
65
60
55
50
45
40
35
30
25
20
15
10
5
0
−90
−75
−60
−45
−30
−15
0
15
30
45
60
75
90
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0.4
0.3
0.45
0.25
0.15
0.2
0.1
0.5
0.3
0.2
0.15

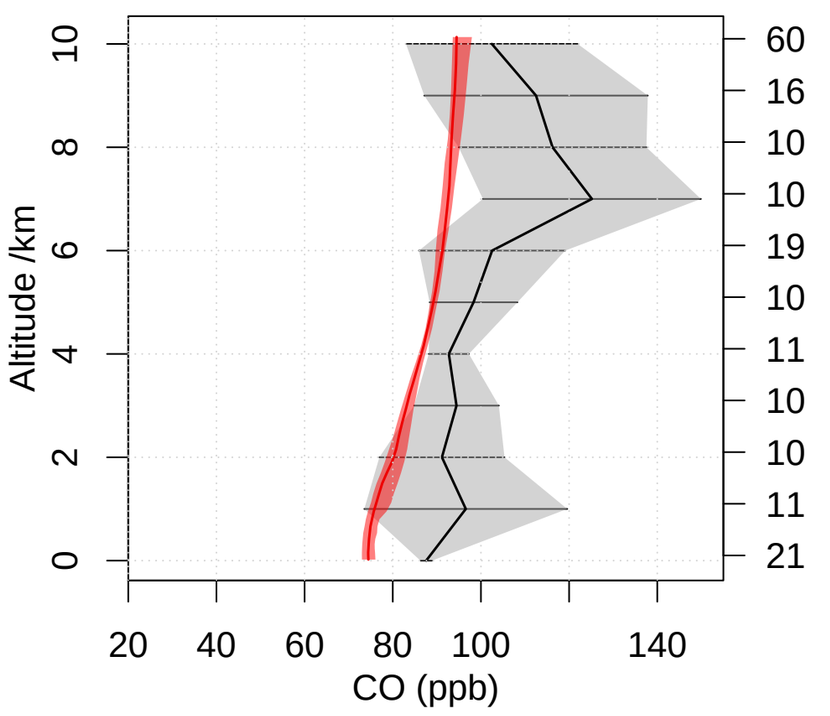

Alert (82.4N, 62.5W, 210m)
xkawa
r = 0.867 MBE = −26%
Barrow (71.3N, 156.6W, 11m)
r = 0.348 MBE = −24%
Mace Head (53.3N, 9.9W, 25m)
r = 0.901 MBE = −11.9%
Park Falls (45.9N, 90.2W, 472m)
r = −0.656 MBE = 45.5%
Niwot Ridge (40.0N, 105.6W, 3475m)
r = −0.395 MBE = 15.1%
Tae−ahn Peninsula (36.7N, 126.1E, 20m)
r = 0.625 MBE = −4.65%
Gozo (36.0N, 14.1E)
r = 0.883 MBE = −23.9%
Key Biscayne (25.7N, 80.2W, 3m)
r = 0.764 MBE = 42.6%
Mauna Loa (19.5N, 155.6W, 3397m)
r = 0.88 MBE = 6.18%
Ragged Point (13.2N, 59.4W, 45m)
r = 0.819 MBE = 4.16%
Christmas Island (1.7N, 157.2W, 3m)
r = 0.139 MBE = 18.1%
Ascension Island (7.9S, 14.4W, 54m)
r = 0.656 MBE = 31.3%
Samoa (14.2S, 170.5W, 42m)
r = 0.849 MBE = 35.3%
Easter Island (27.1S, 109.4W, 50m)
r = 0.922 MBE = 29.7%
Cape Grim (40.7S, 144.7E, 94m)
r = 0.845 MBE = 65.2%
Crozet Island (46.5S, 51.8E, 120m)
r = 0.966 MBE = 48.7%
Syowa Station (69.0S, 39.6E, 11m)
r = 0.992 MBE = 56.8%
South Pole (90.0S, 24.8W, 2810m)
r = 0.985 MBE = 59%
CO (ppb)
Jan
Mar
May
Jul
Sep
Nov

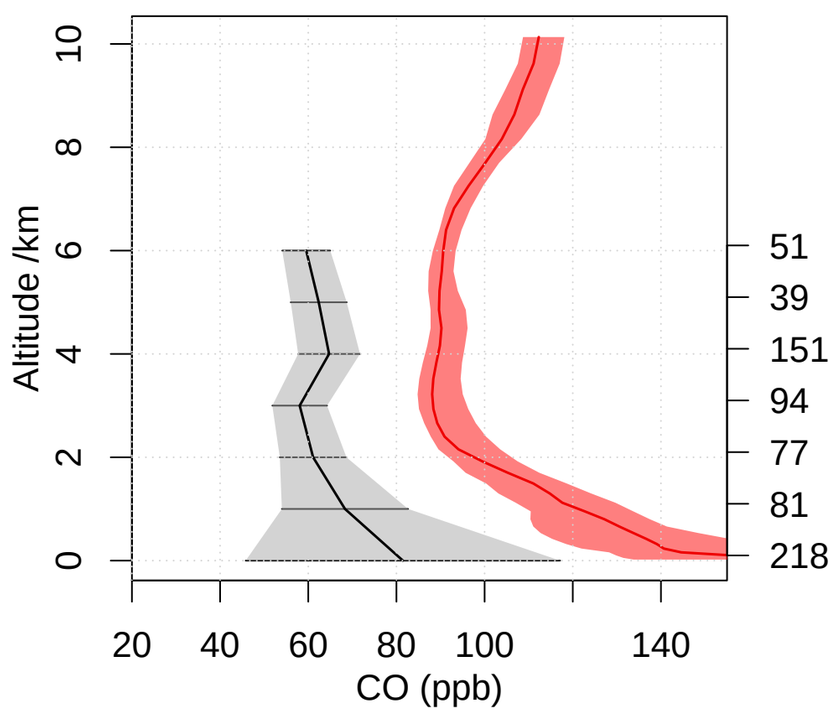
# Emmons CO comparison

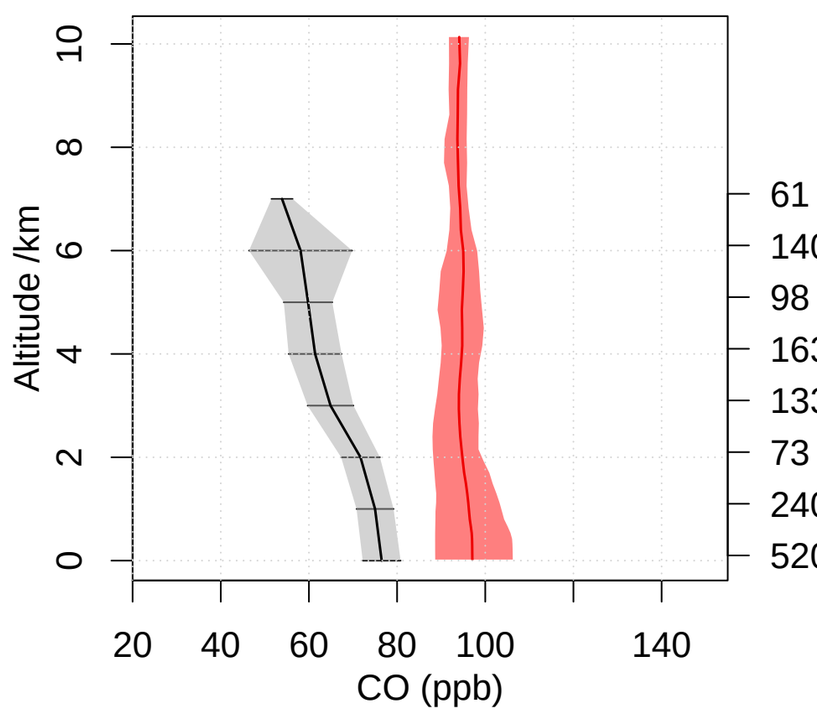


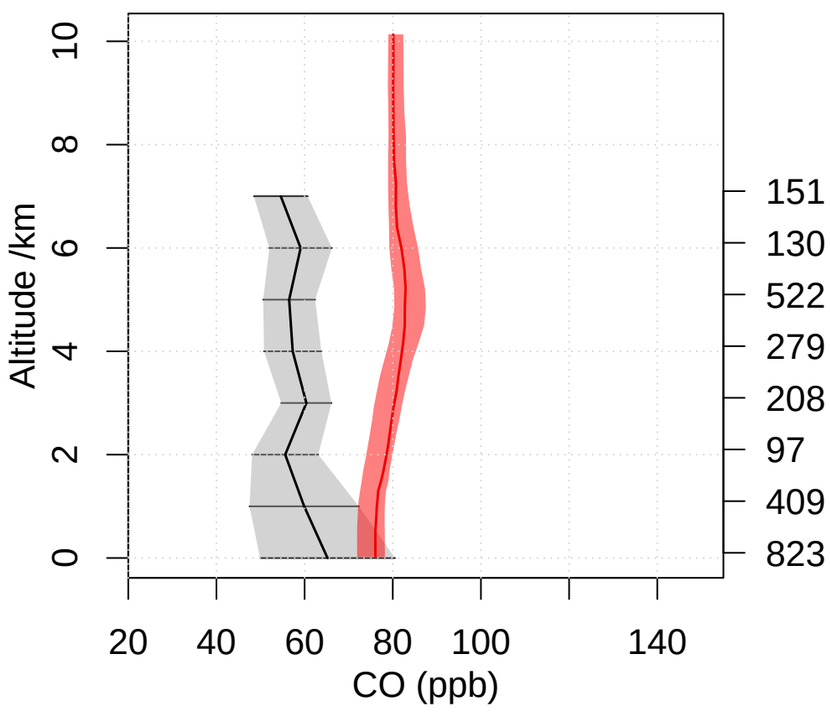



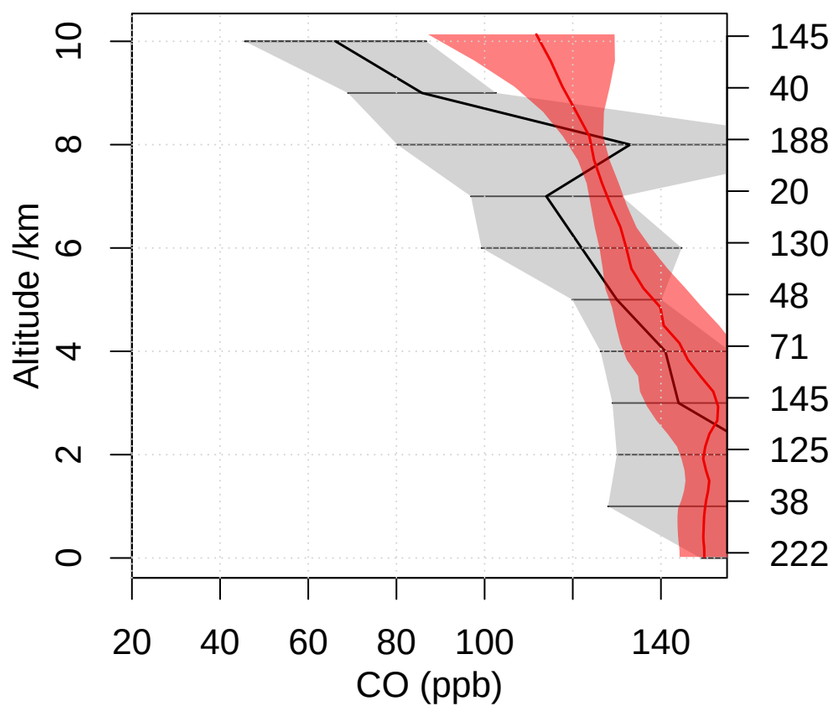



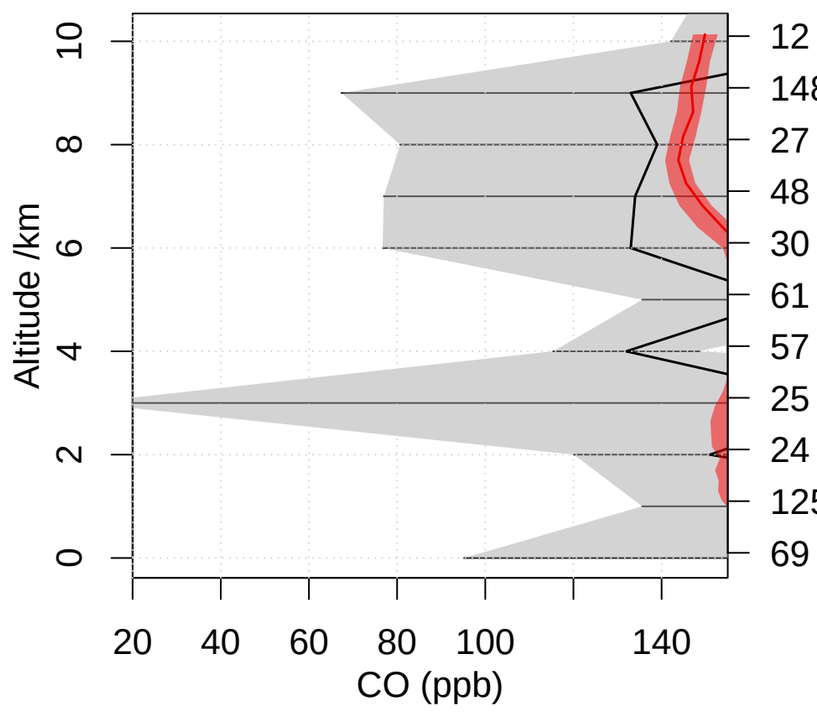



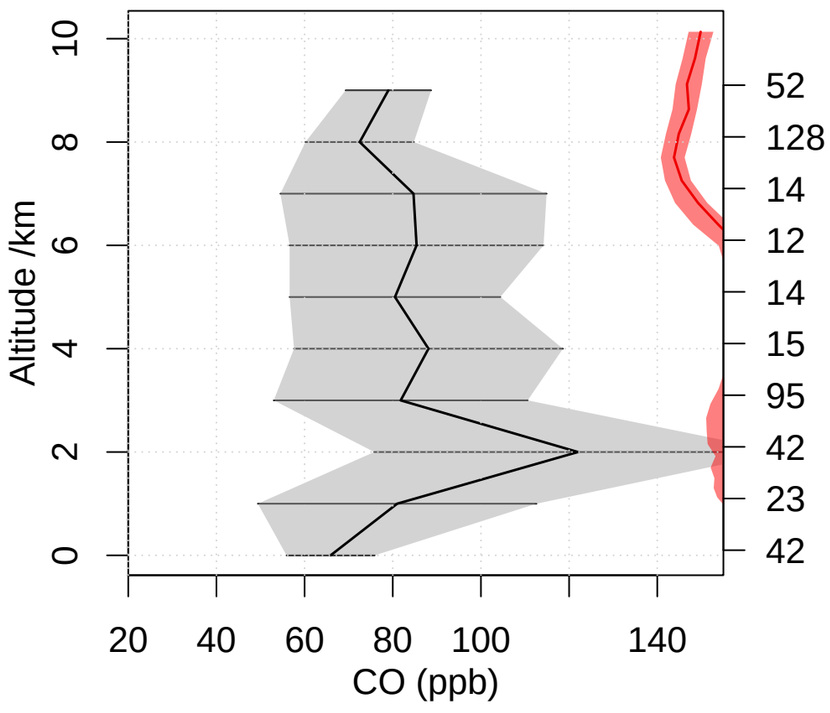



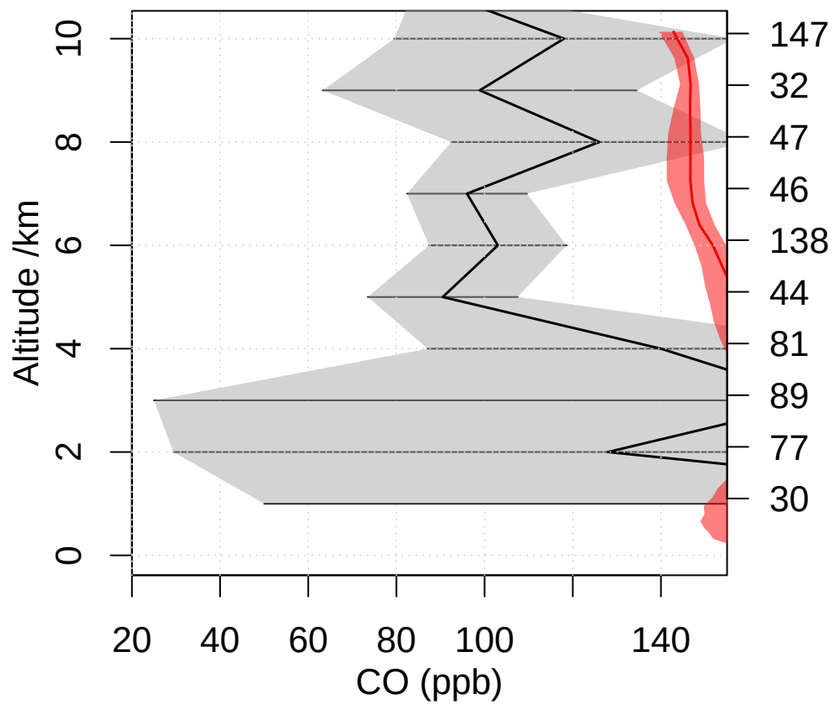



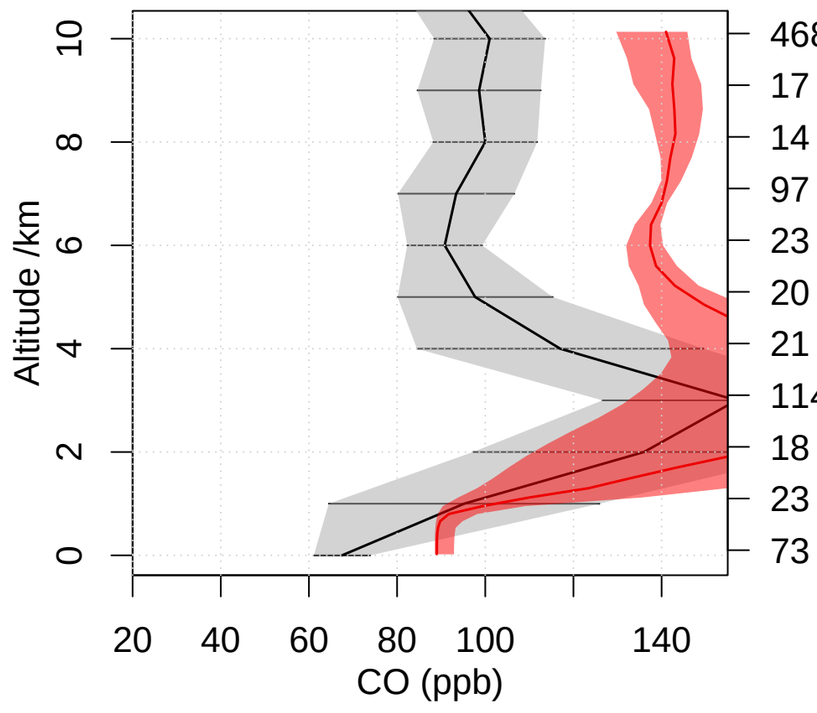



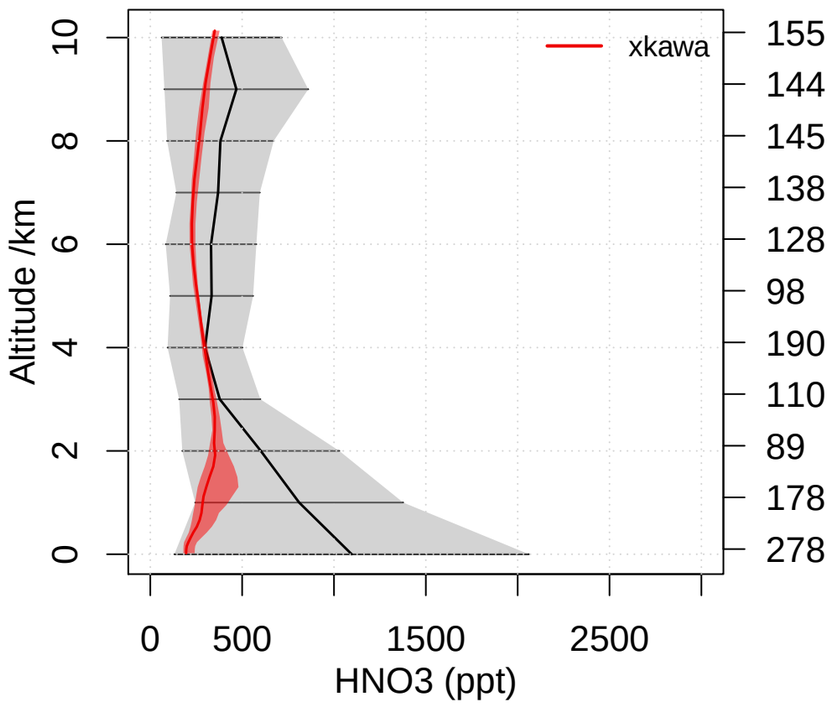



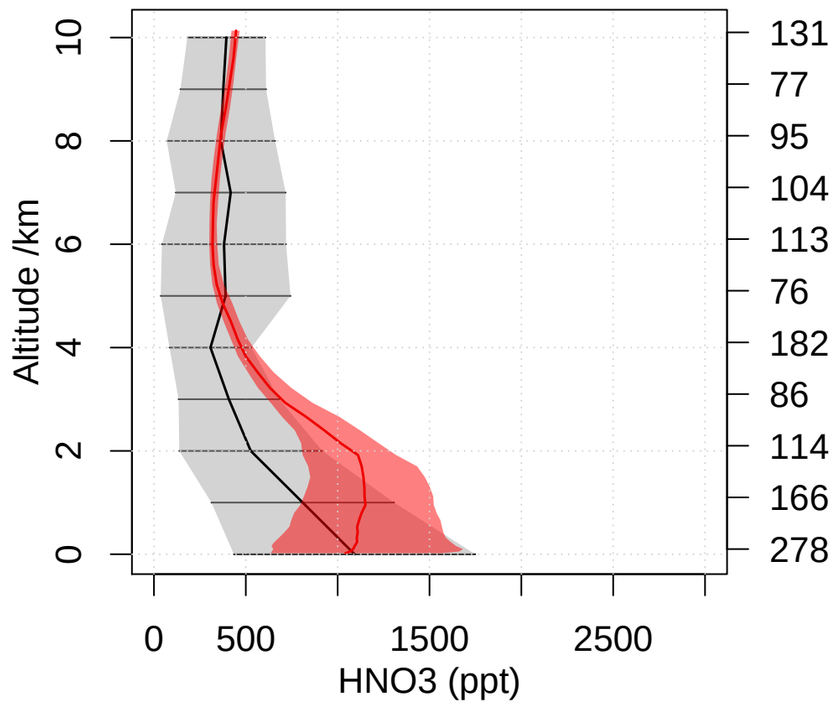



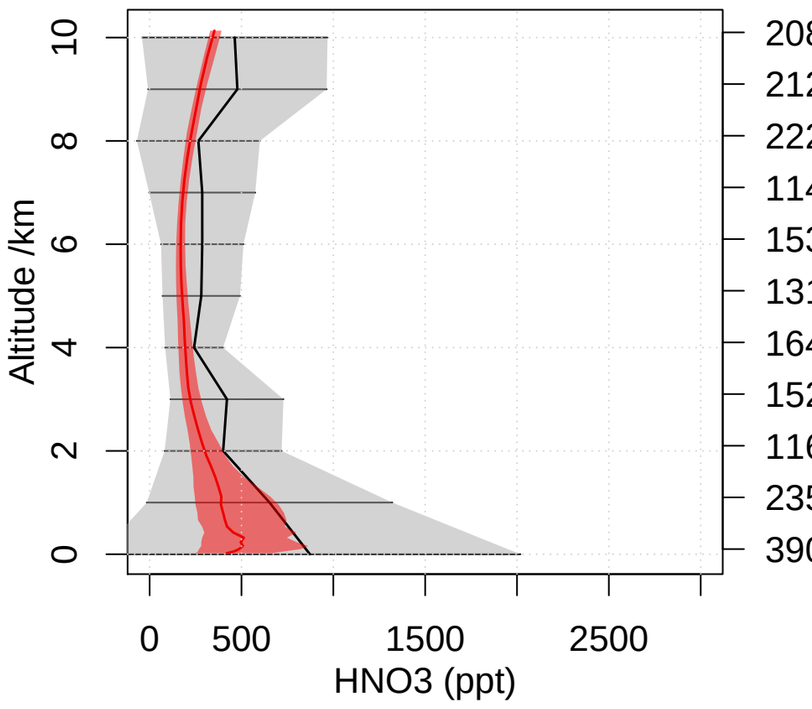



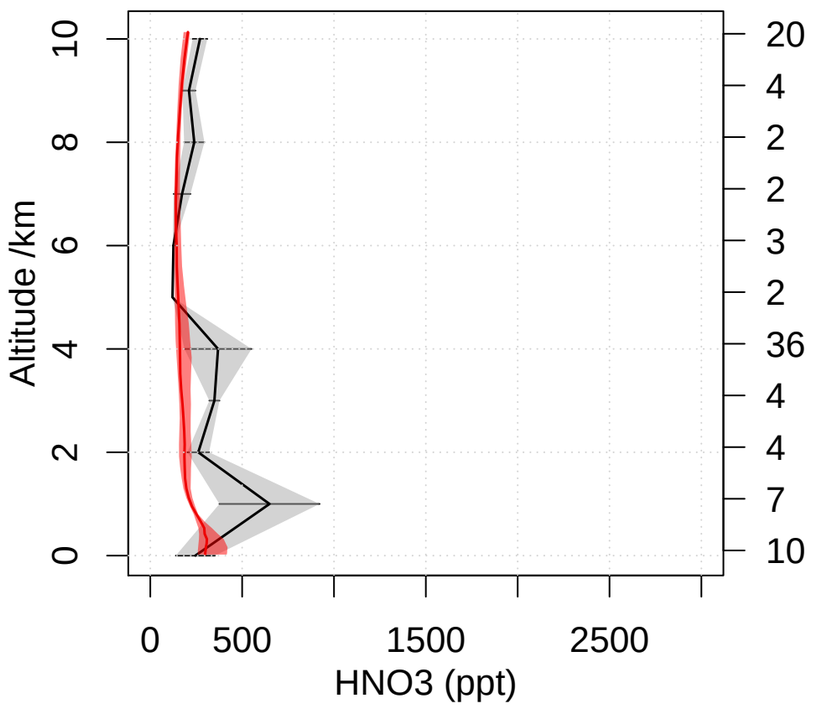



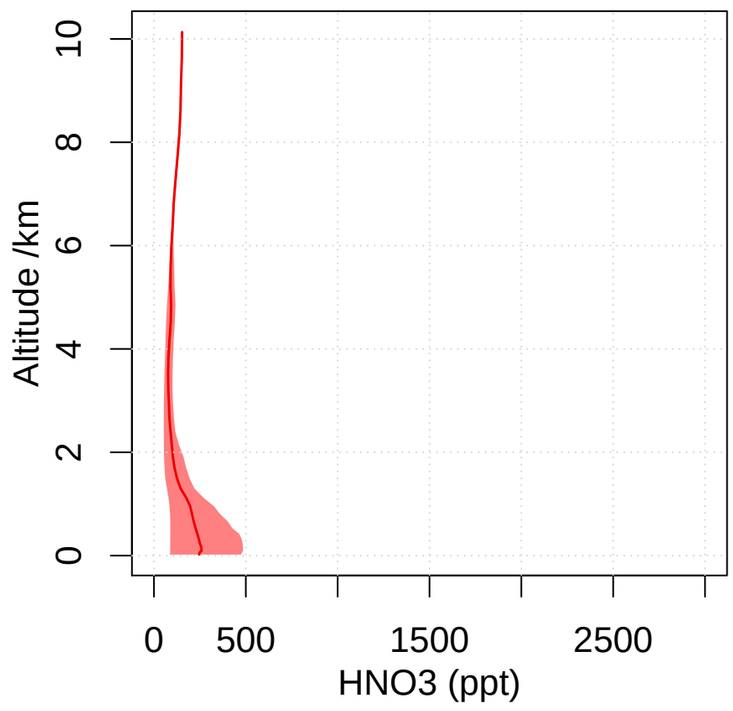
# Emmons HNO3 comparison

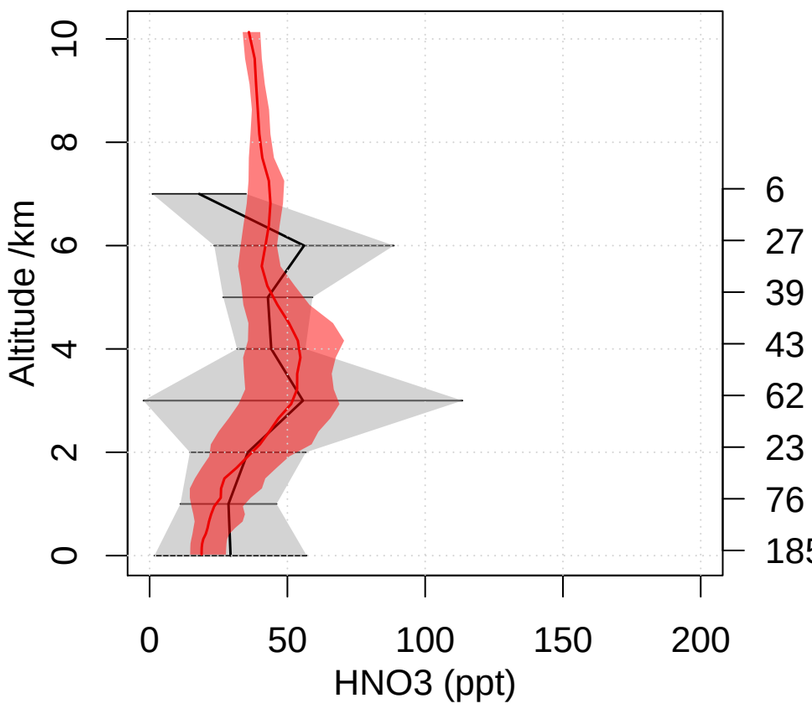


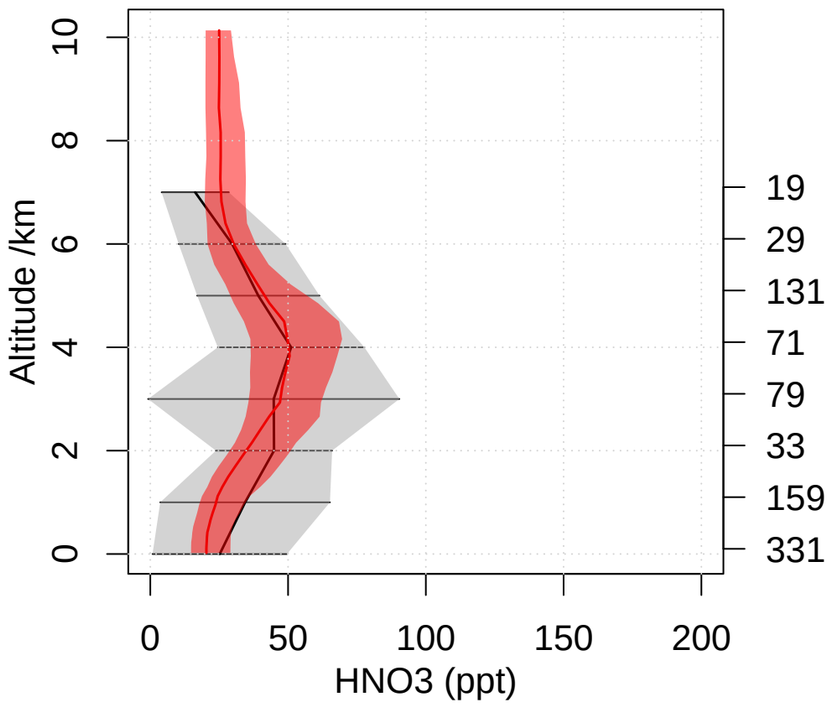



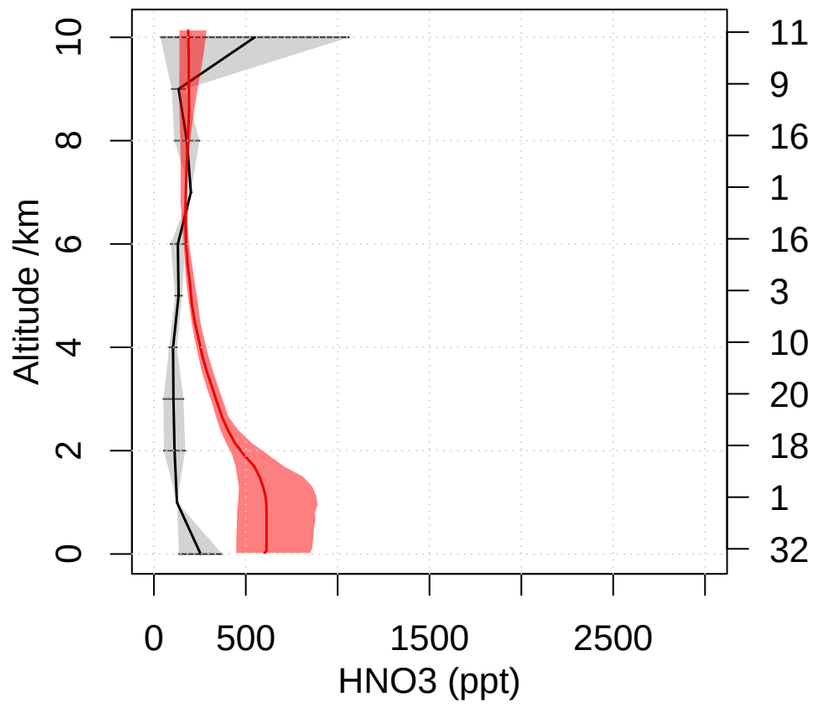



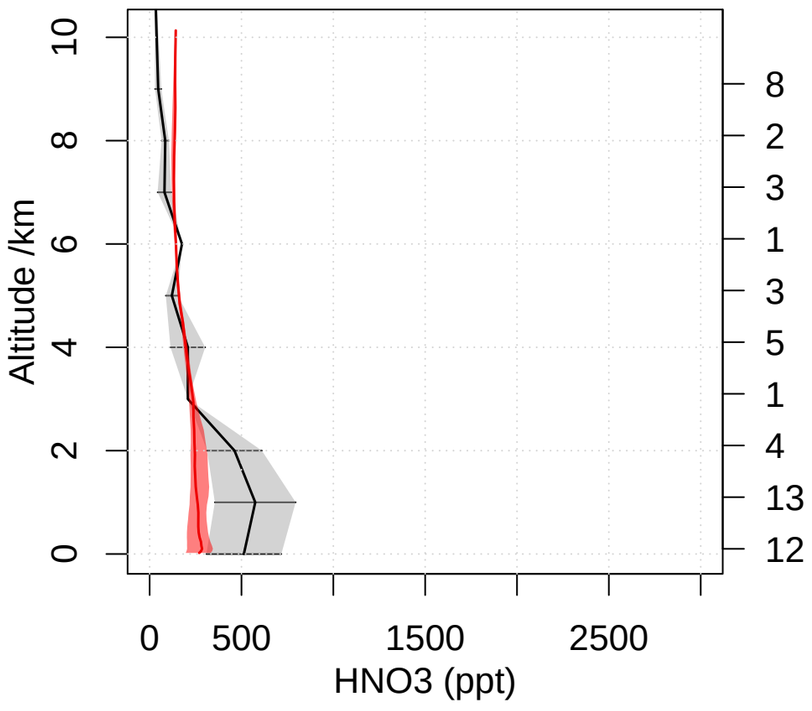



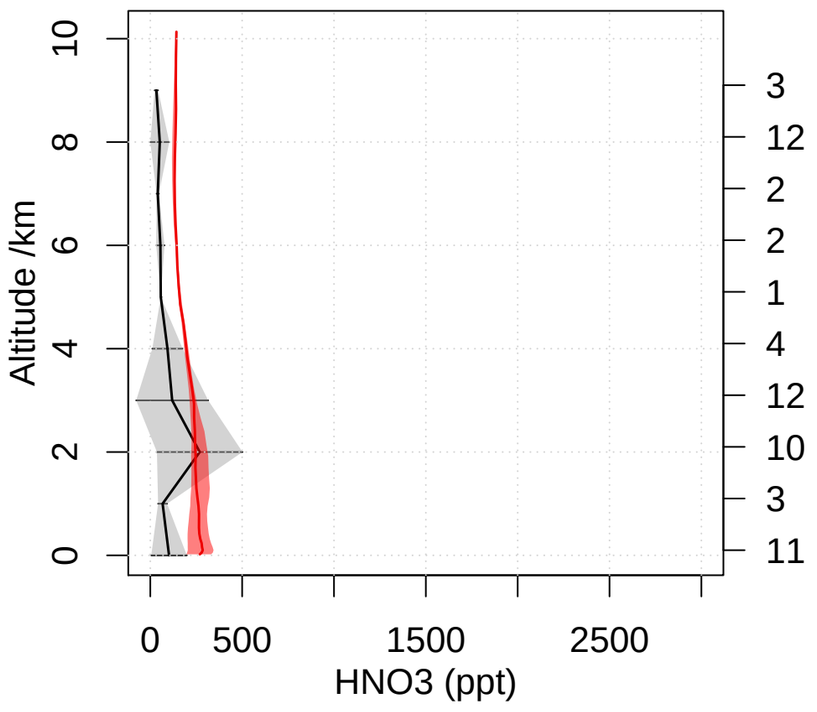



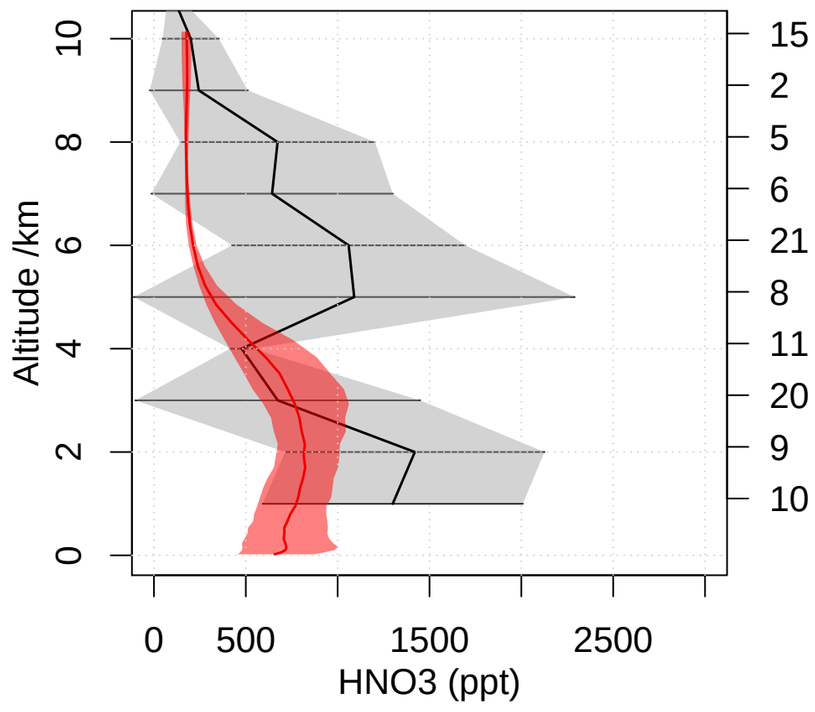



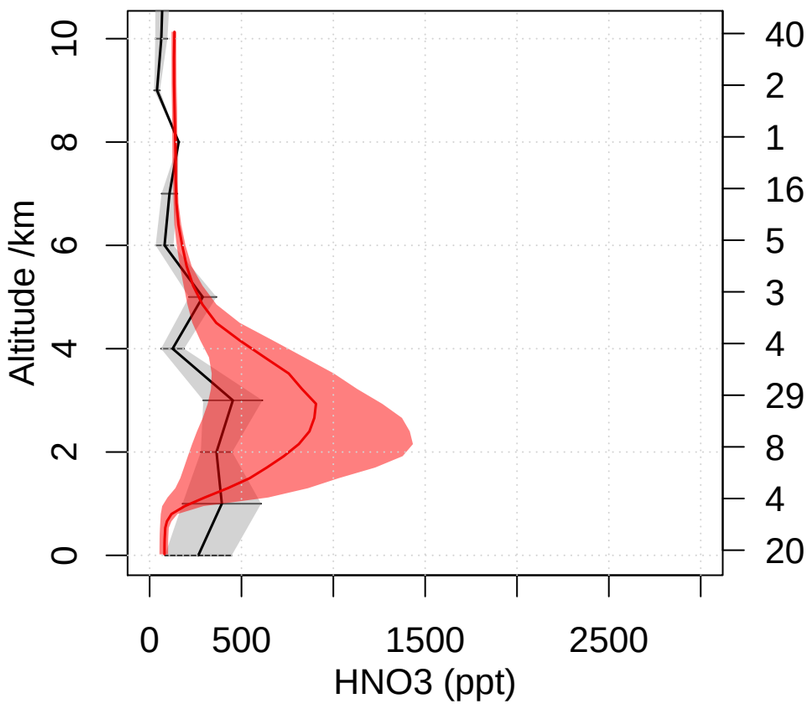



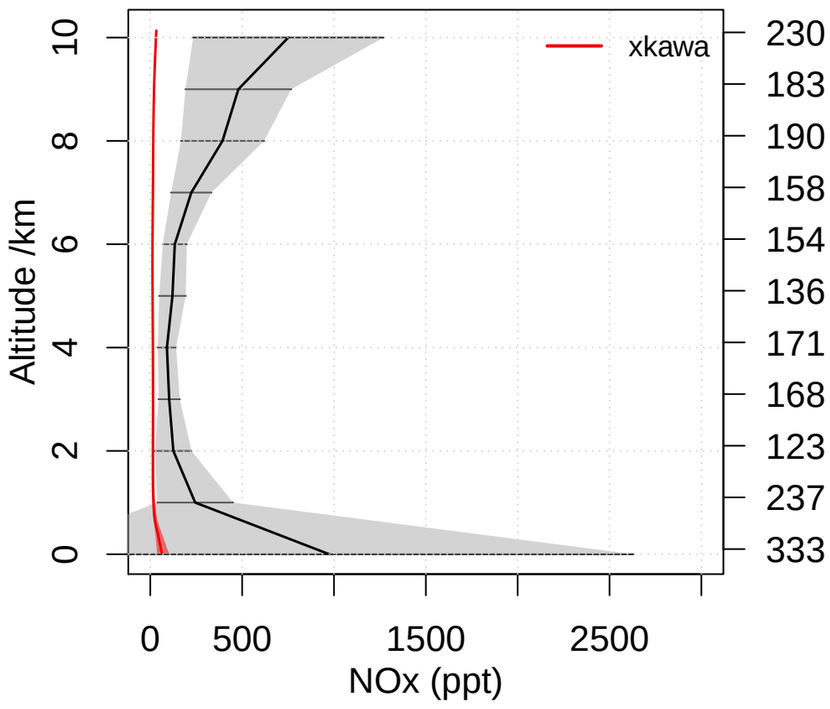



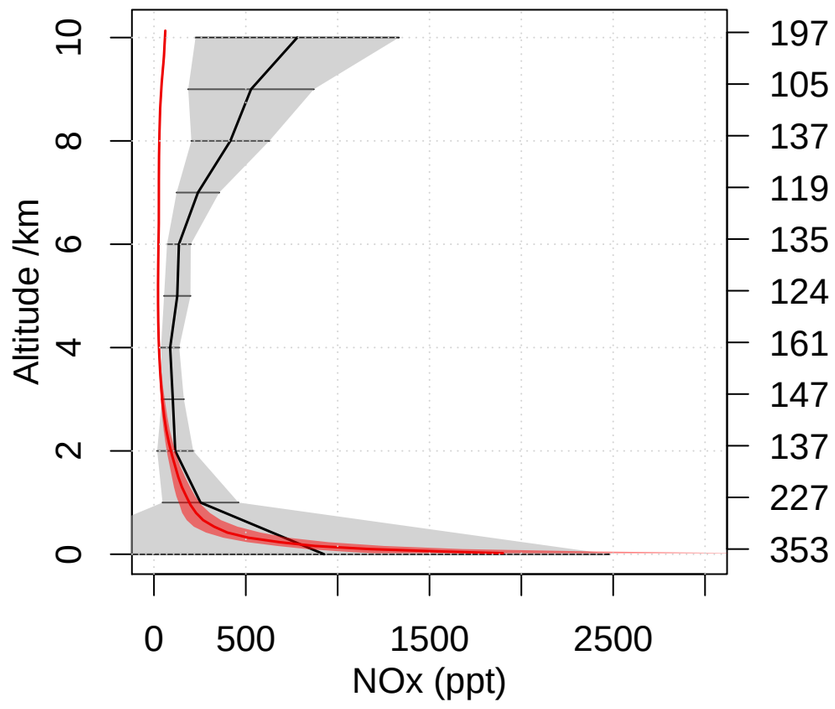



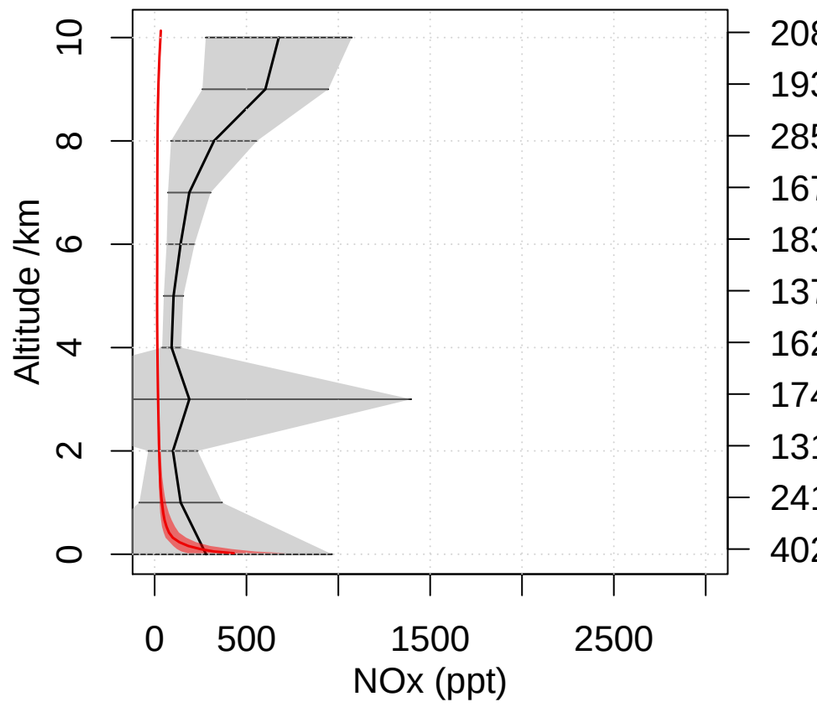



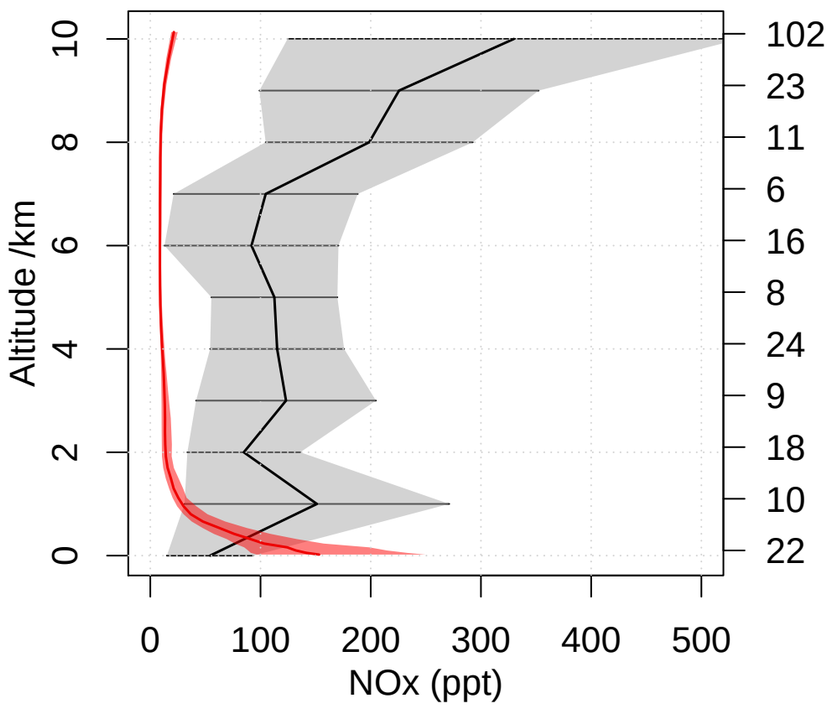



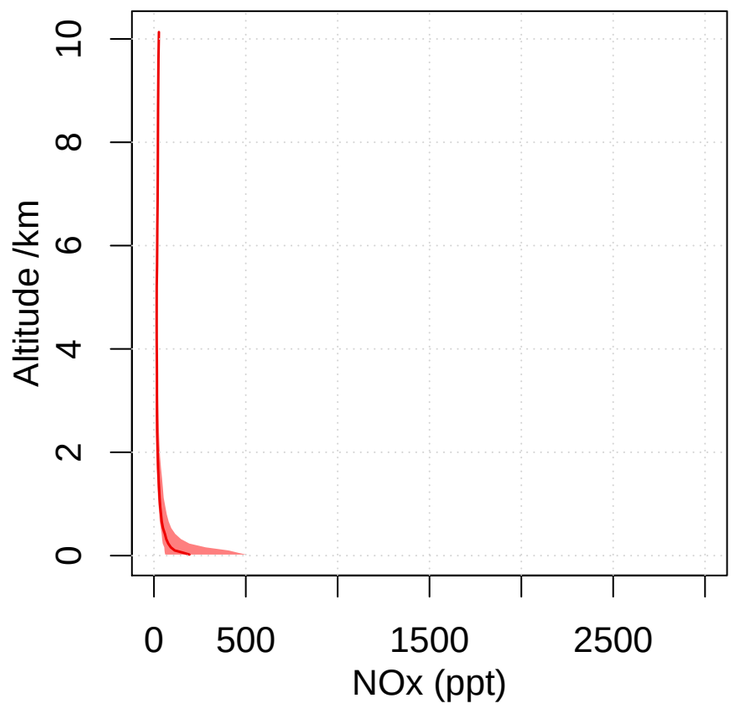
# Emmons NOx comparison

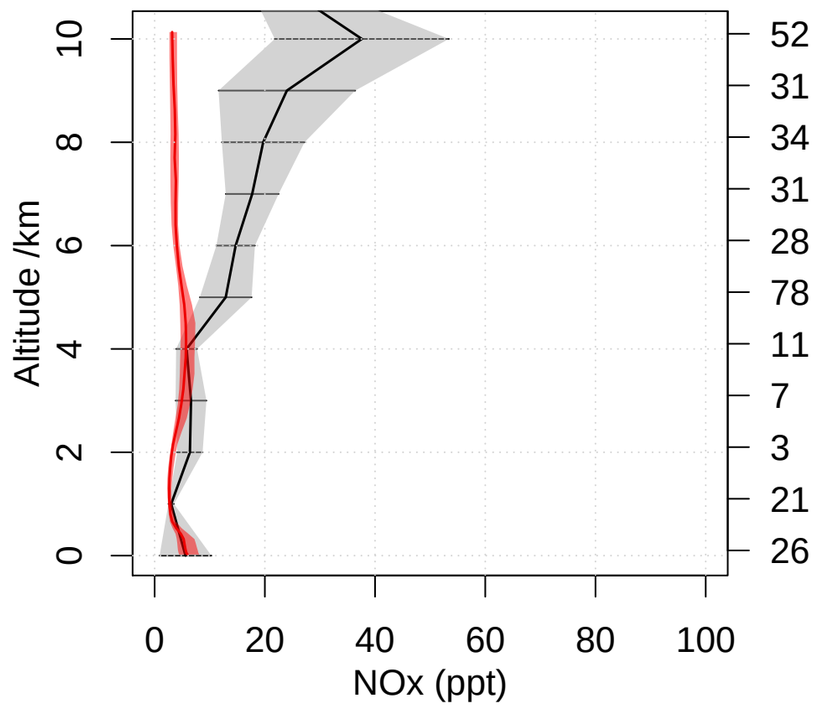


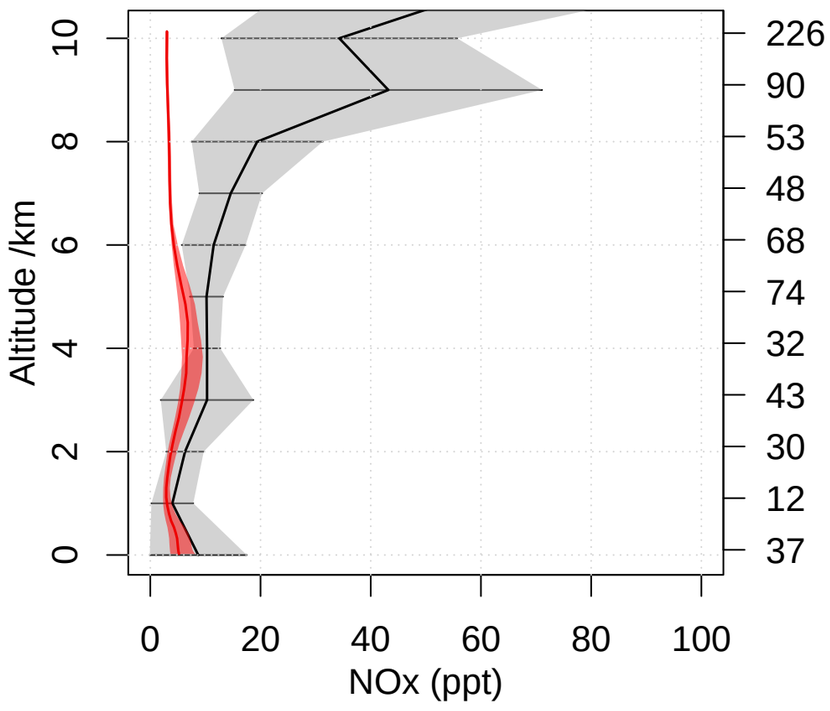



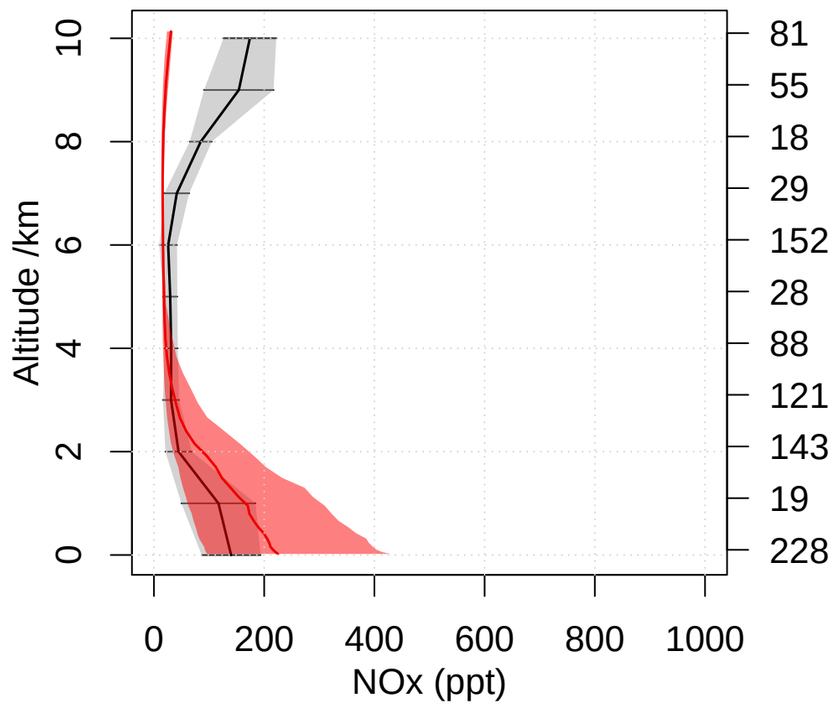



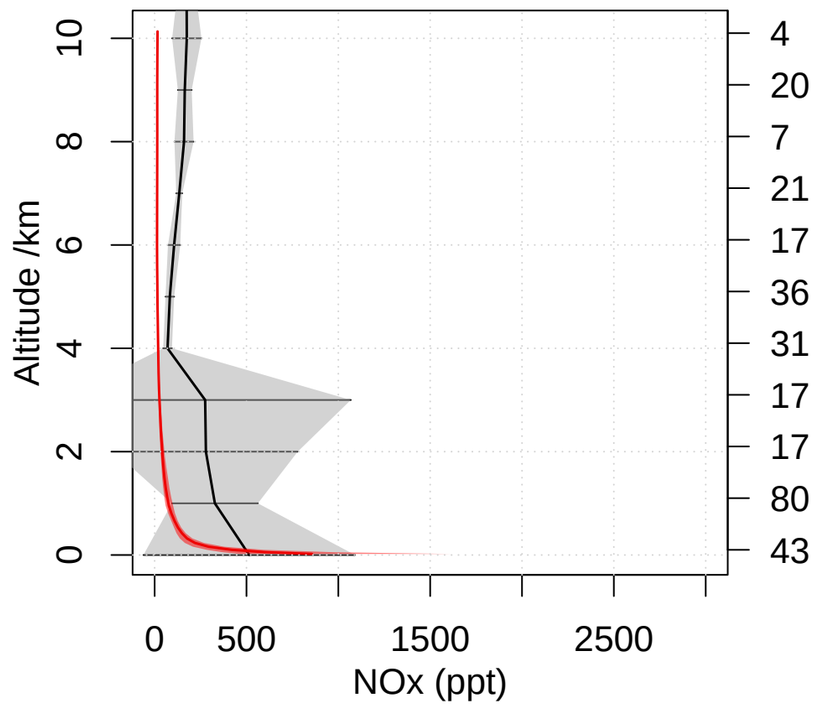



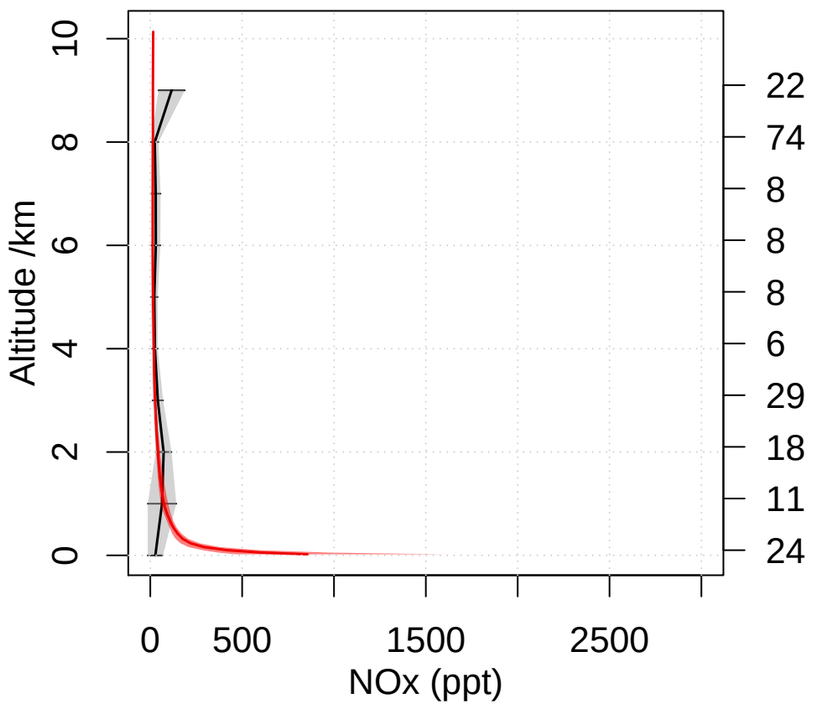



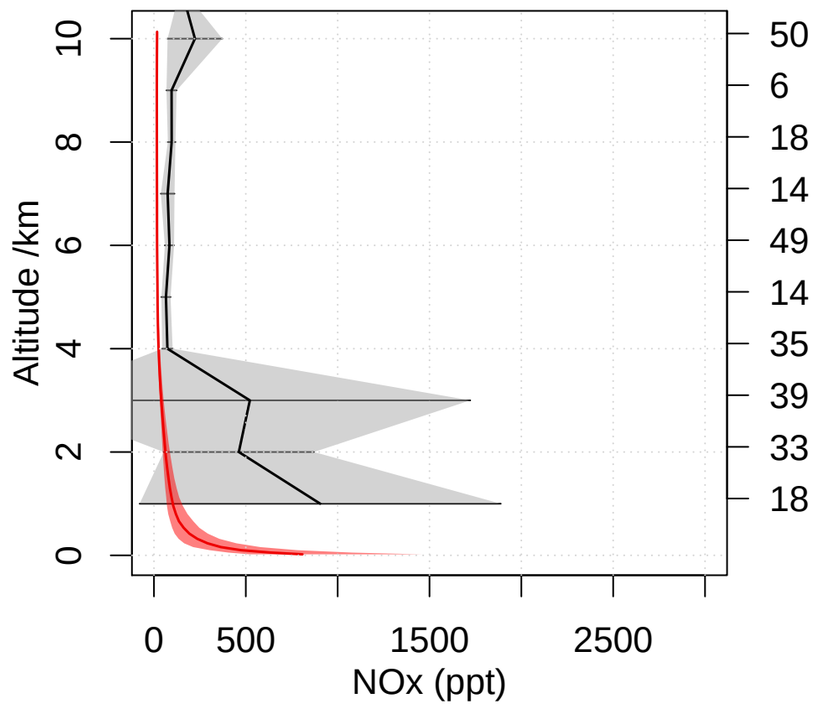



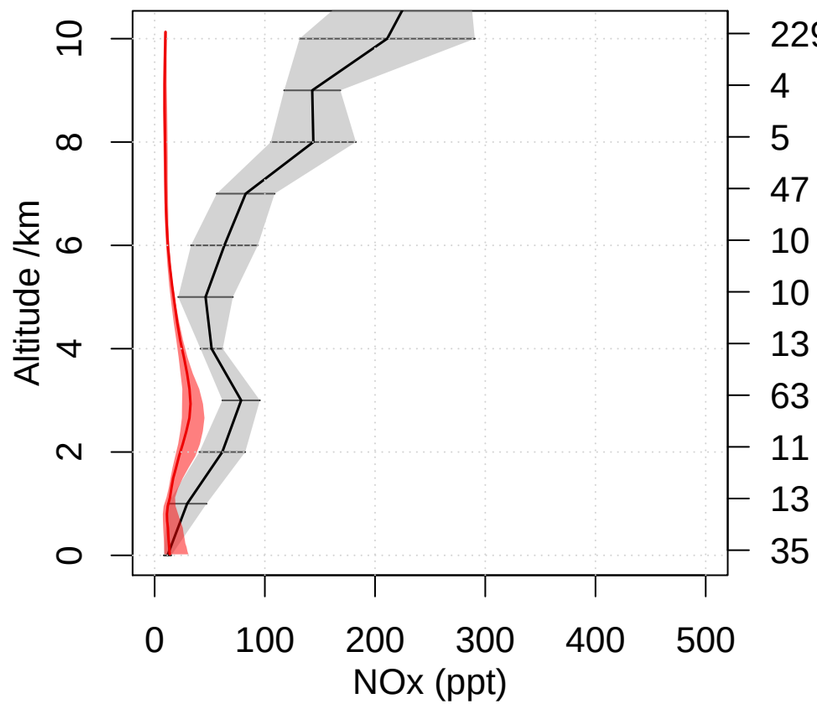



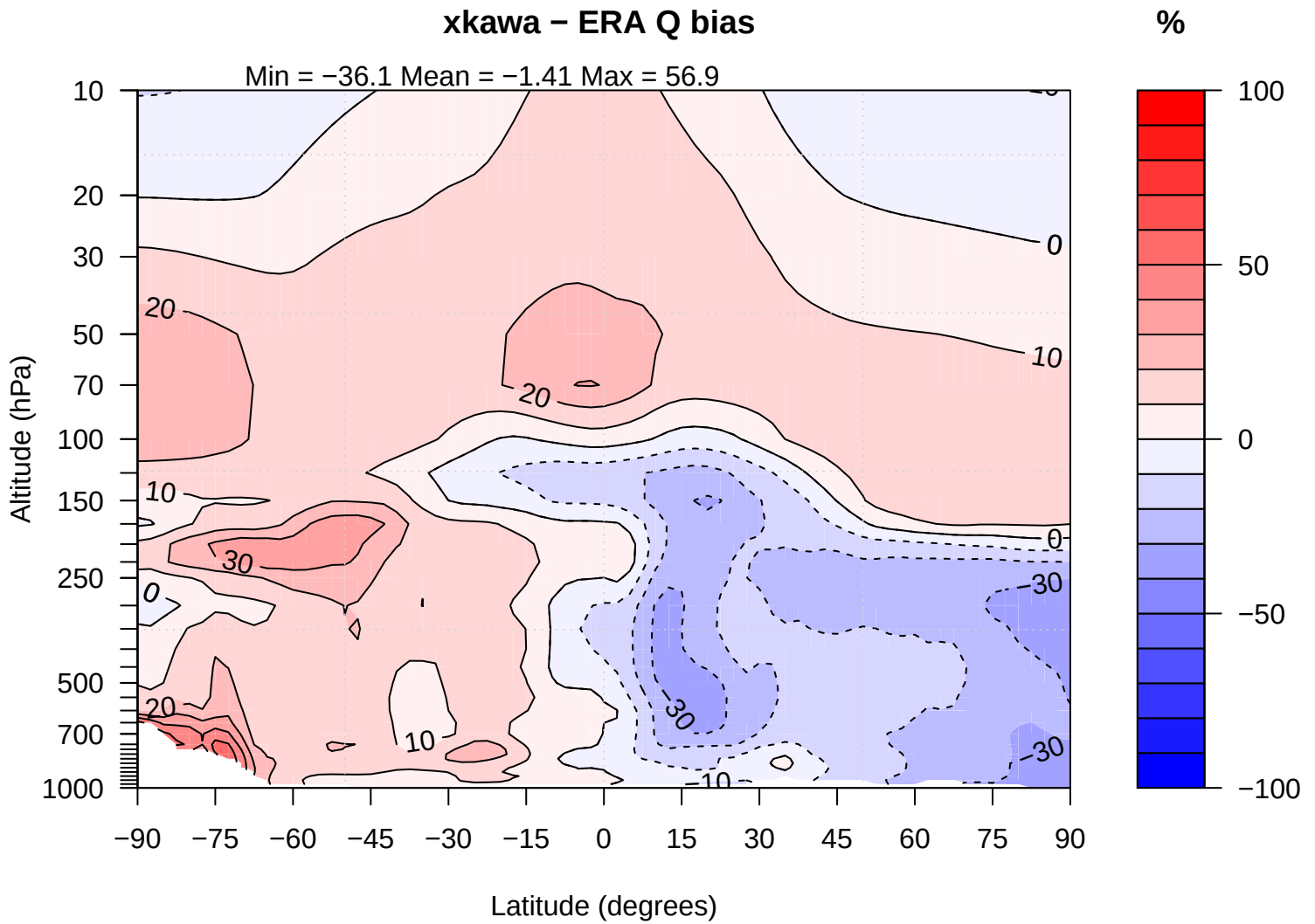



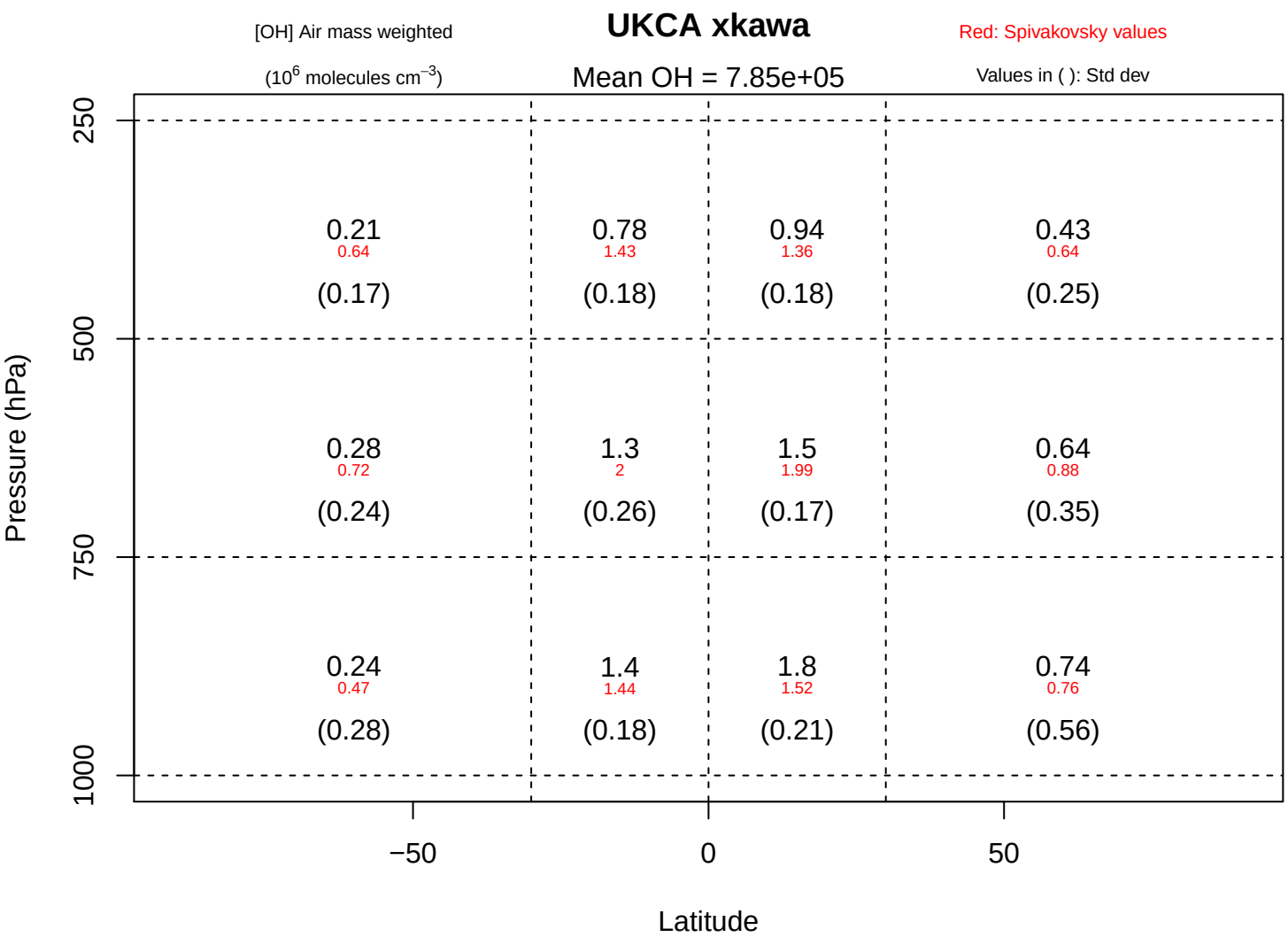



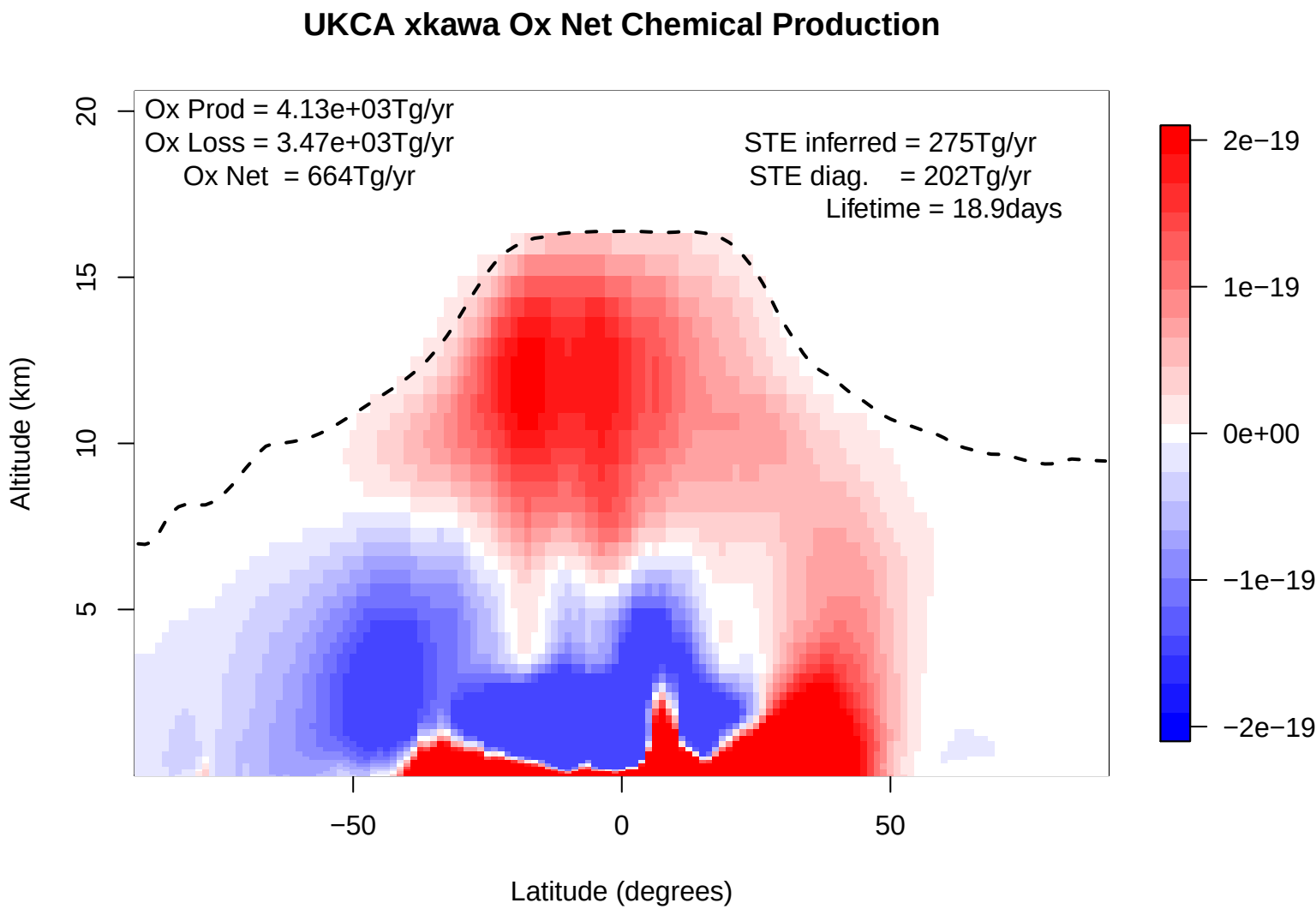



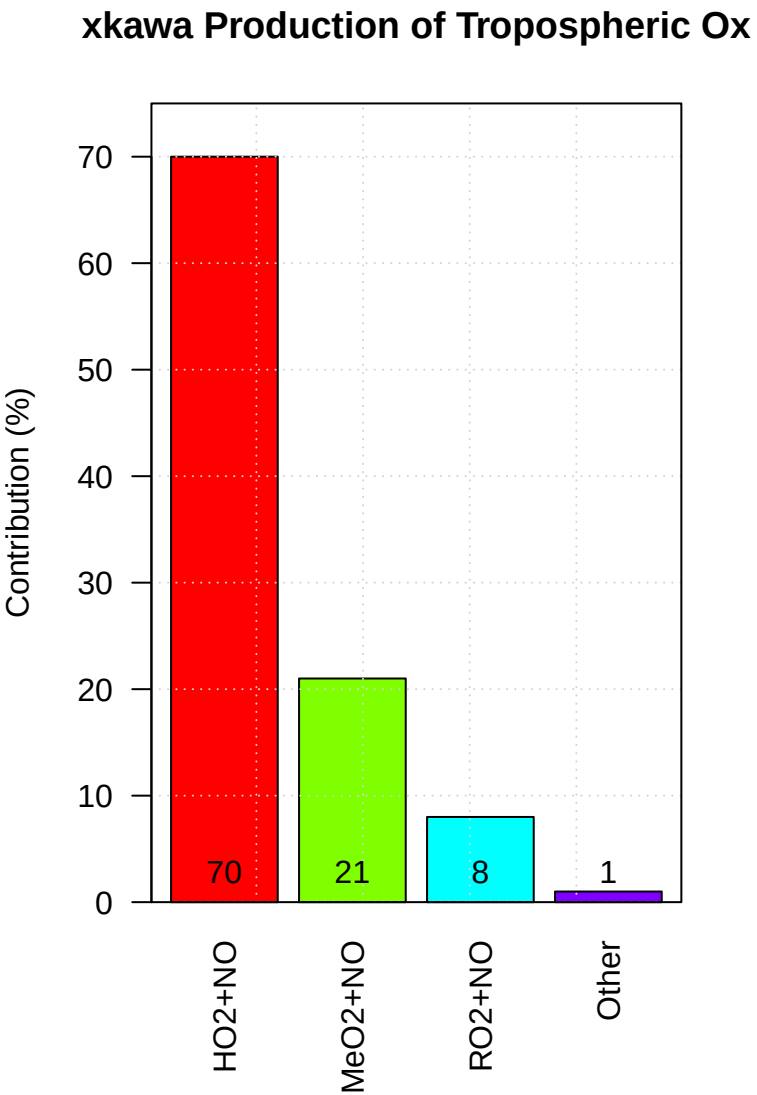



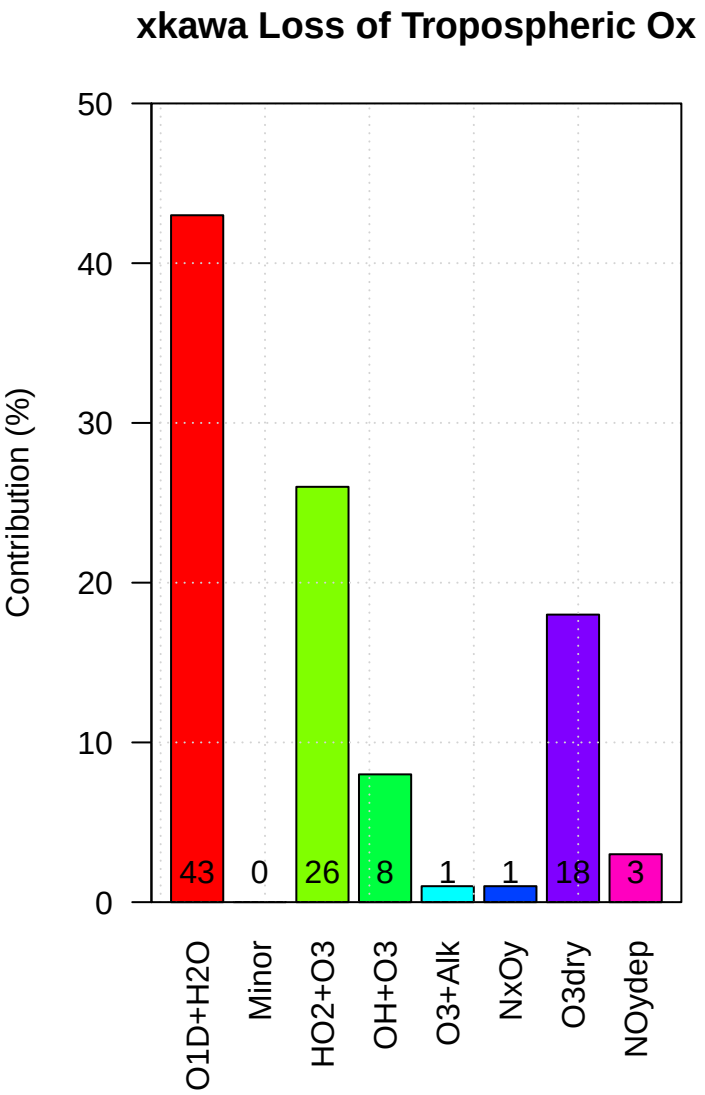



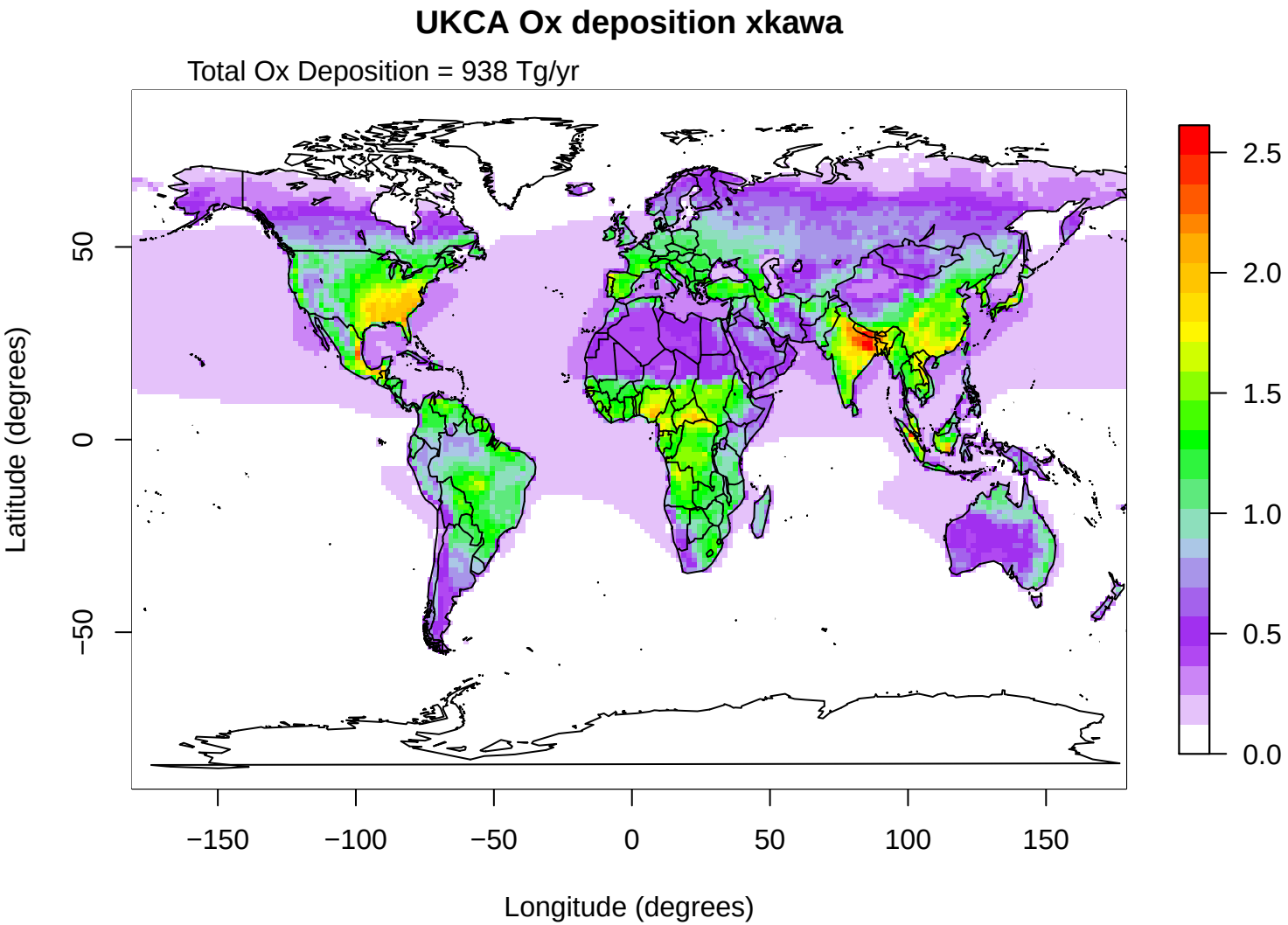

xkawa − ERA Q bias
%
Min = −36.1 Mean = −1.41 Max = 56.9
Altitude (hPa)
10
20
30
50
70
100
150
250
500
700
1000
Latitude (degrees)
−90
−75
−60
−45
−30
−15
0
15
30
45
60
75
90
100
50
0
−50
−100

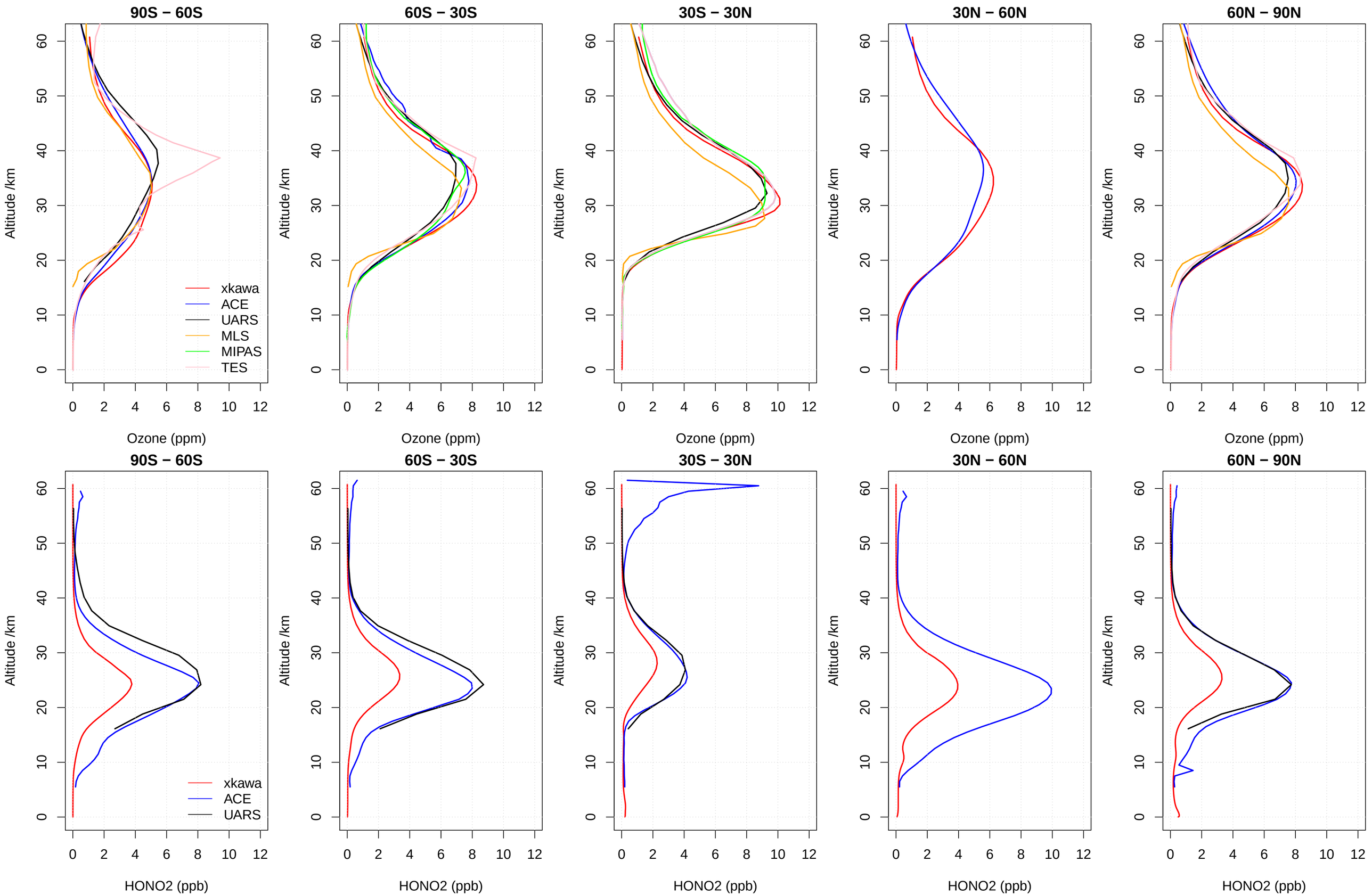

UKCA xkawa
[OH] Air mass weighted
($10^6$ molecules $cm^{-3}$)
Mean OH = 7.85e+05
Red: Spivakovsky values
Values in ( ): Std dev
0.21
0.64
(0.17)
0.78
1.43
(0.18)
0.94
1.36
(0.18)
0.43
0.64
(0.25)
0.28
0.72
(0.24)
1.3
2
(0.26)
1.5
1.99
(0.17)
0.64
0.88
(0.35)
0.24
0.47
(0.28)
1.4
1.44
(0.18)
1.8
1.52
(0.21)
0.74
0.76
(0.56)
Pressure (hPa)
250
500
750
1000
−50
0
50
Latitude

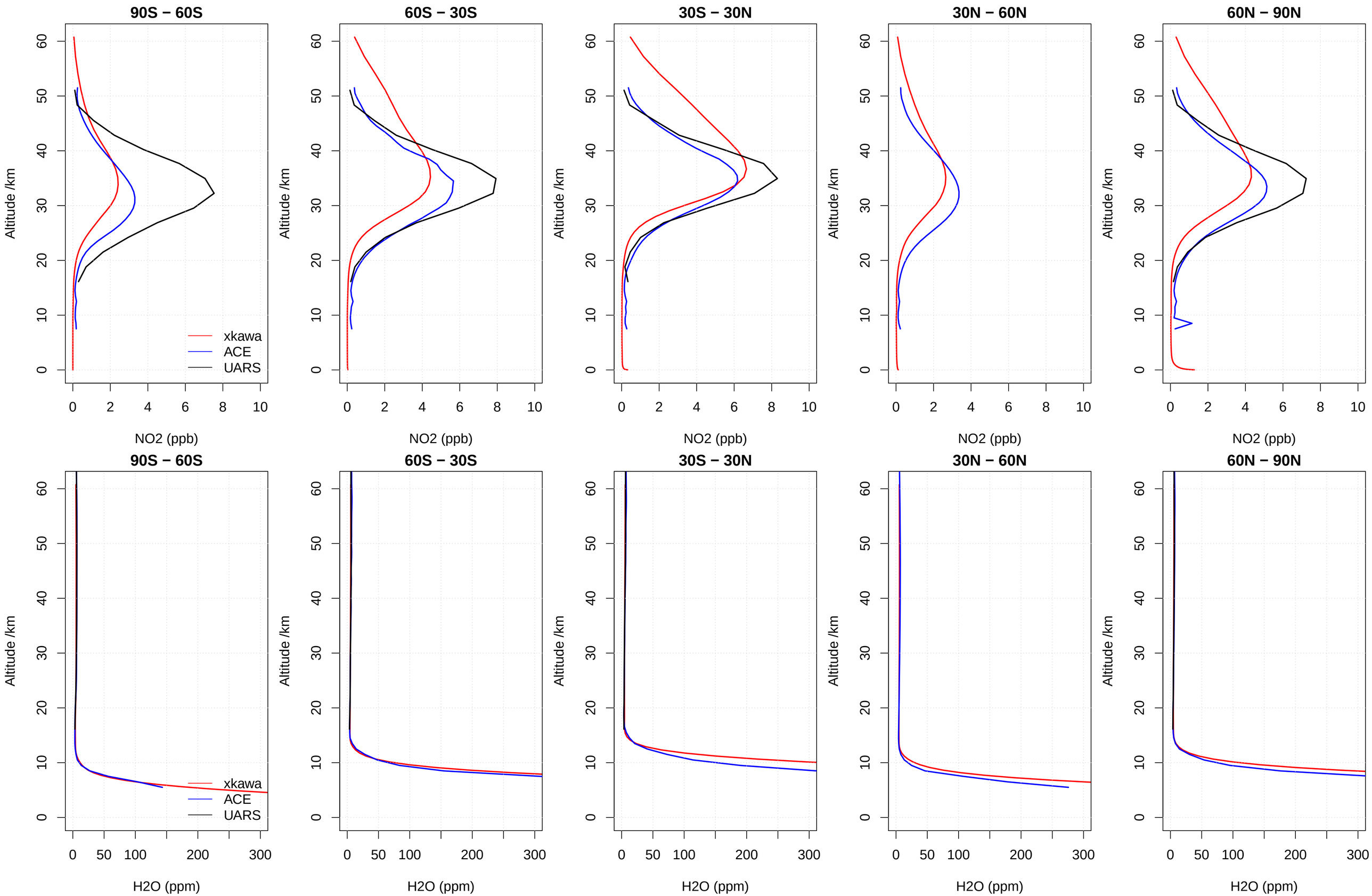

UKCA xkawa Ox Net Chemical Production
Ox Prod = 4.13e+03Tg/yr
Ox Loss = 3.47e+03Tg/yr
Ox Net = 664Tg/yr
STE inferred = 275Tg/yr
STE diag. = 202Tg/yr
Lifetime = 18.9days
Altitude (km)
20
15
10
5
−50
0
50
Latitude (degrees)
2e−19
1e−19
0e+00
−1e−19
−2e−19

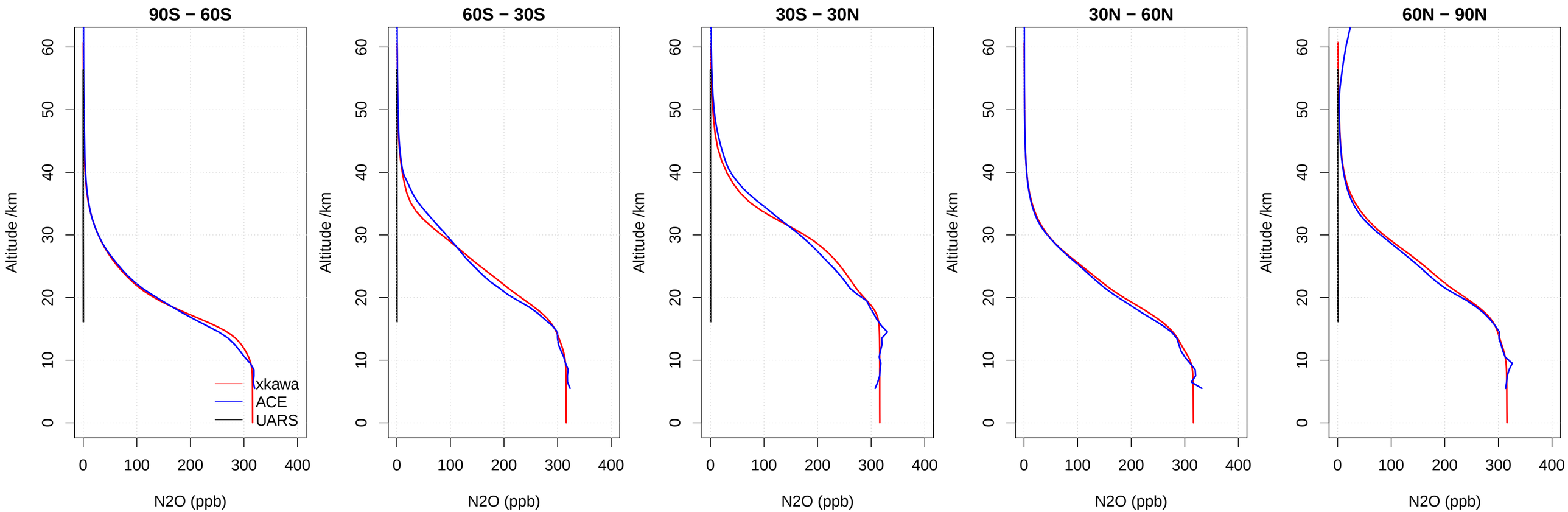

xkawa Production of Tropospheric Ox
Contribution (%)
0
10
20
30
40
50
60
70
70
21
8
1
HO2+NO
MeO2+NO
RO2+NO
Other

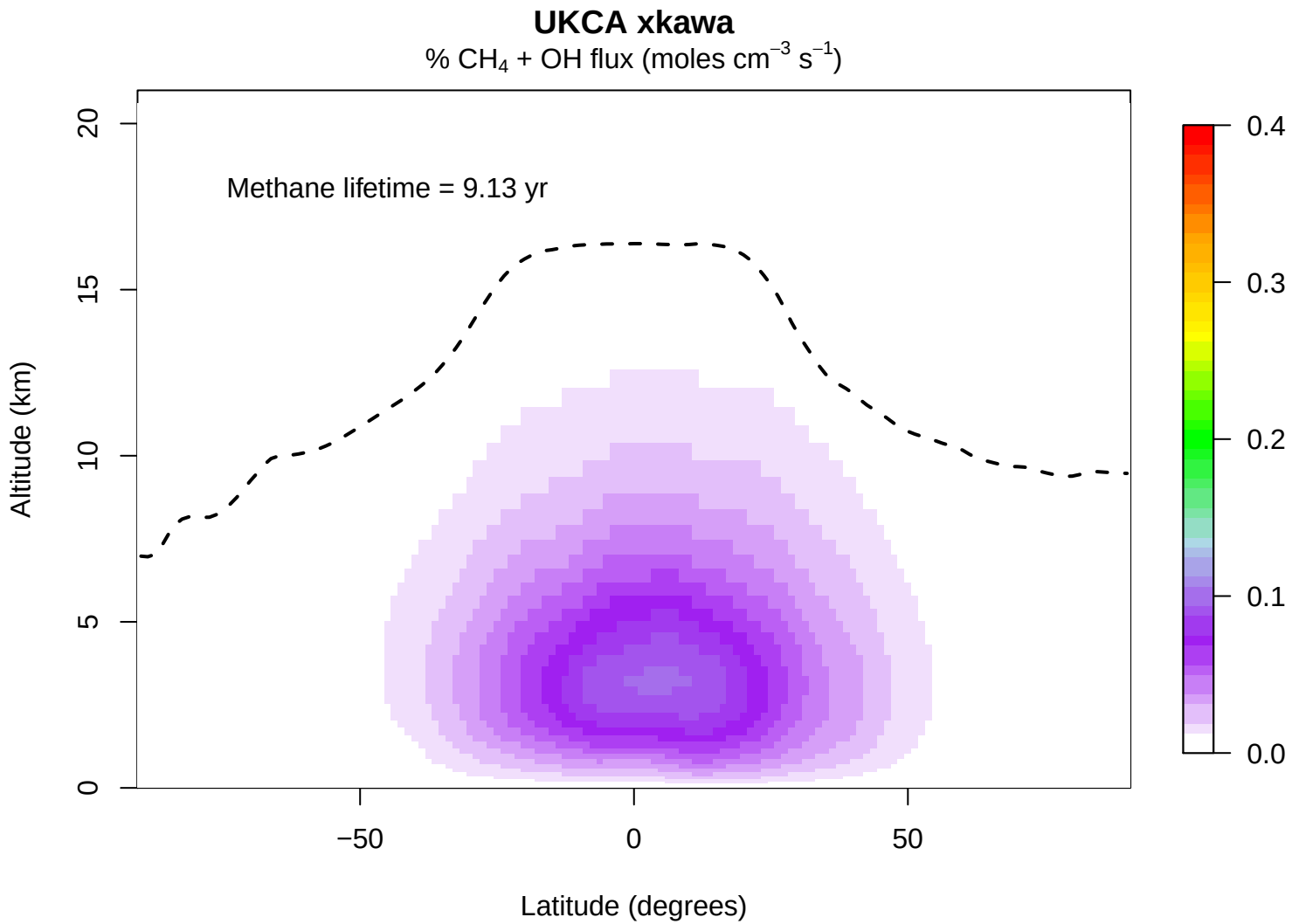

xkawa Loss of Tropospheric Ox
Contribution (%)
0
10
20
30
40
50
43
0
26
8
1
1
18
3
O1D+H2O
Minor
HO2+O3
OH+O3
O3+Alk
NxOy
O3dry
NOydep

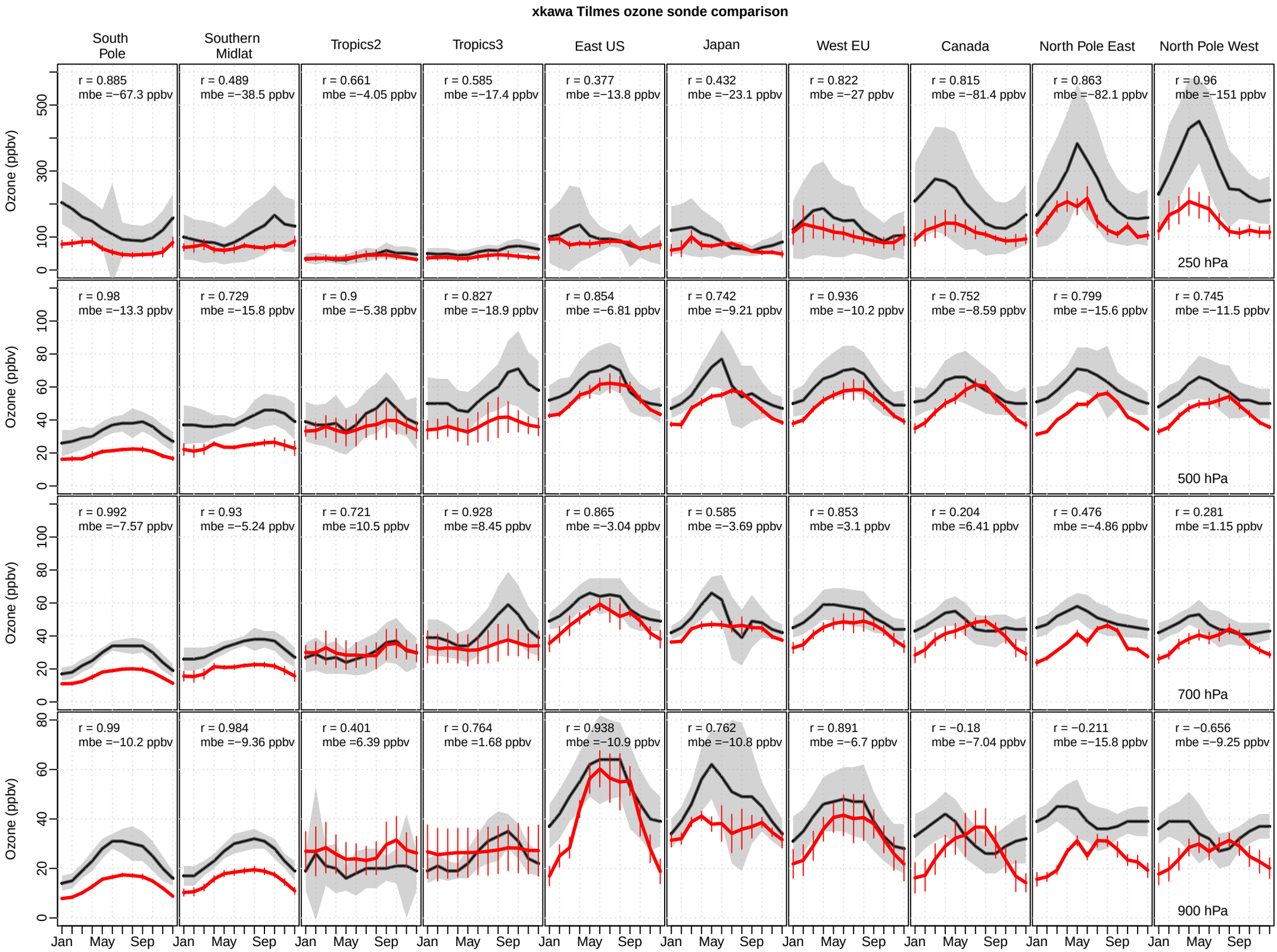

UKCA Ox deposition xkawa
Total Ox Deposition = 938 Tg/yr
Latitude (degrees)
50
0
−50
−150
−100
−50
0
50
100
150
Longitude (degrees)
2.5
2.0
1.5
1.0
0.5
0.0

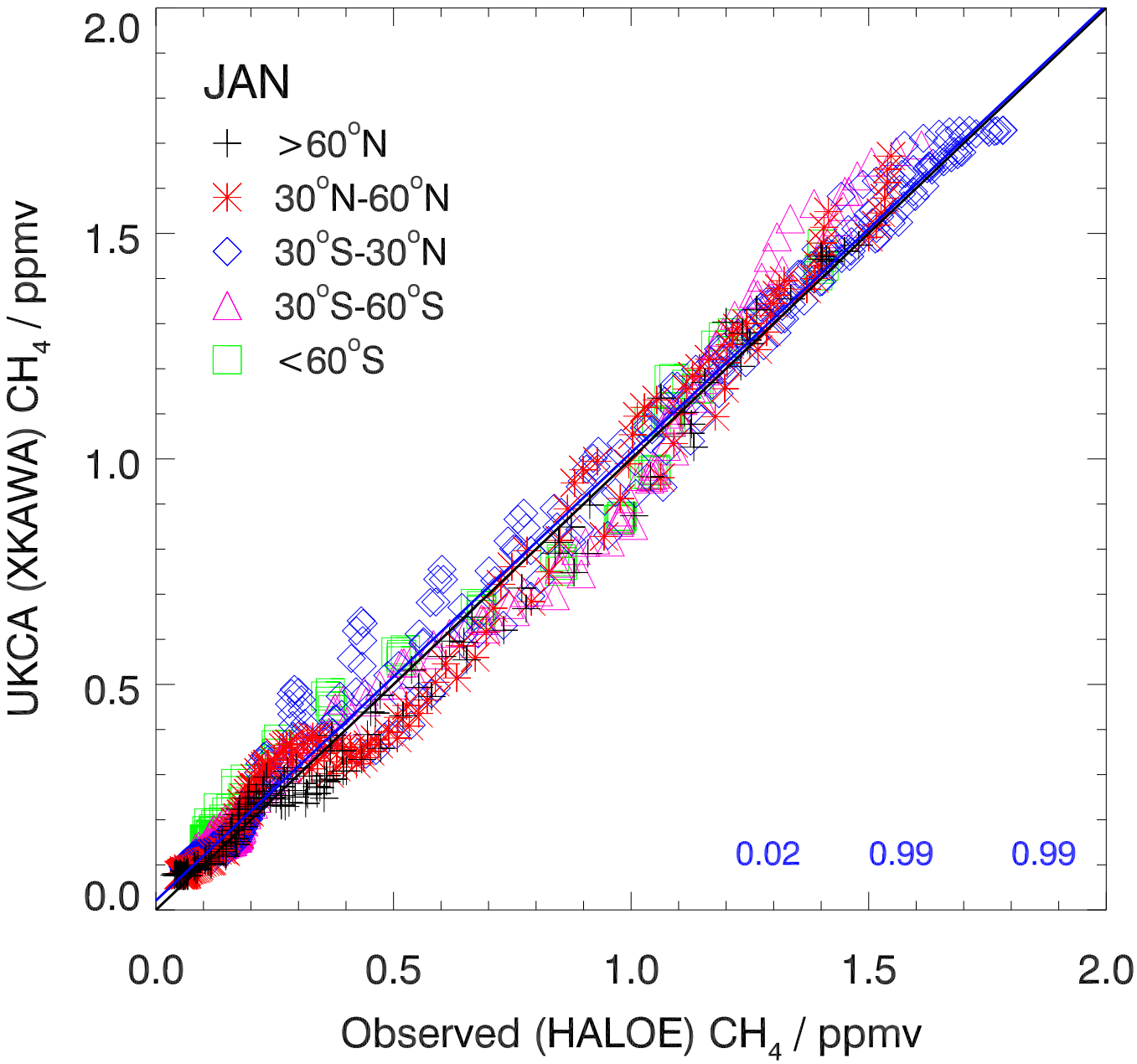

90S – 60S
60S – 30S
30S – 30N
30N – 60N
60N – 90N
Altitude /km
Ozone (ppm)
xkawa
ACE
UARS
MLS
MIPAS
TES
HONO2 (ppb)

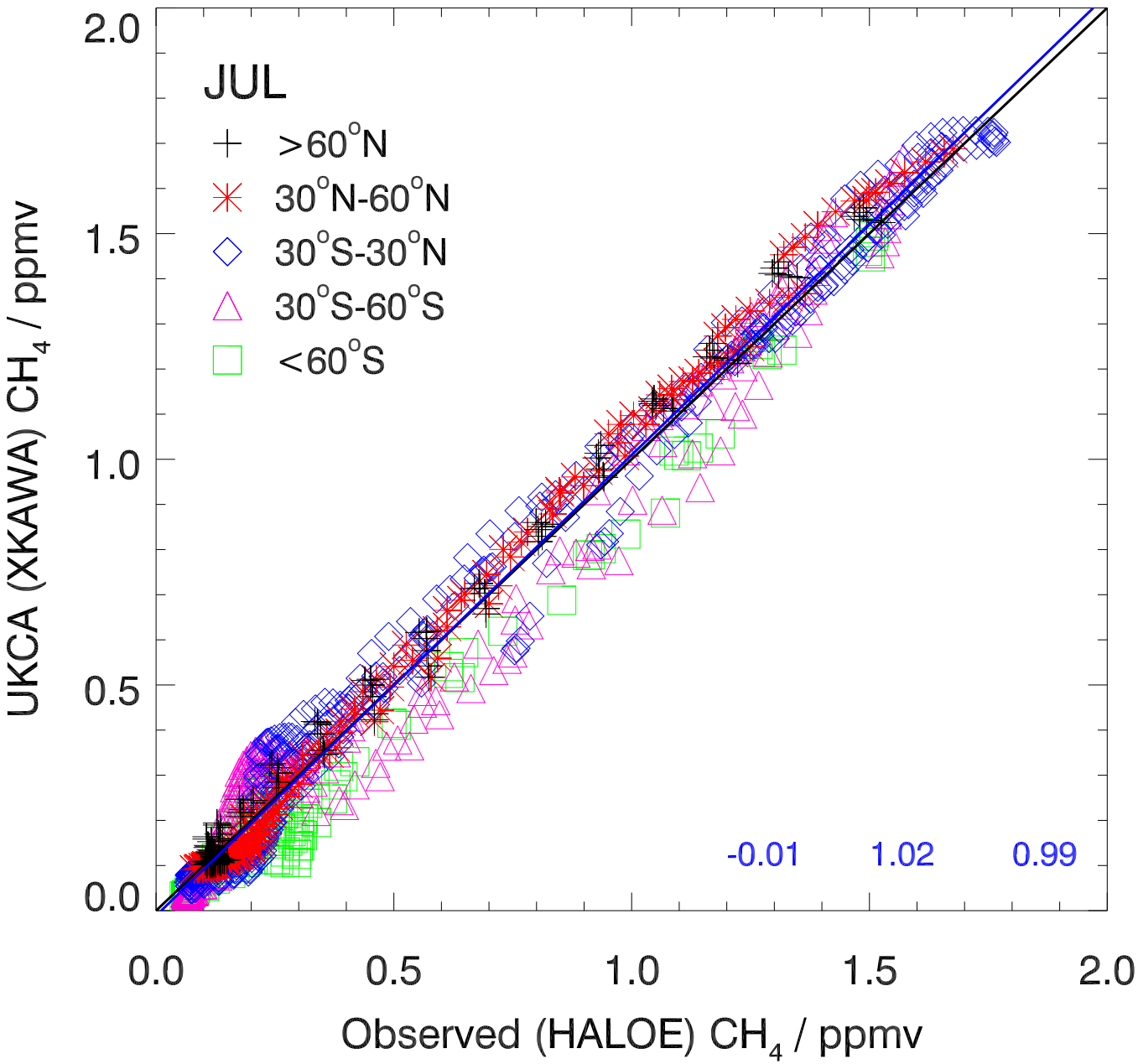

90S – 60S
60S – 30S
30S – 30N
30N – 60N
60N – 90N
Altitude /km
NO2 (ppb)
H2O (ppm)
xkawa
ACE
UARS

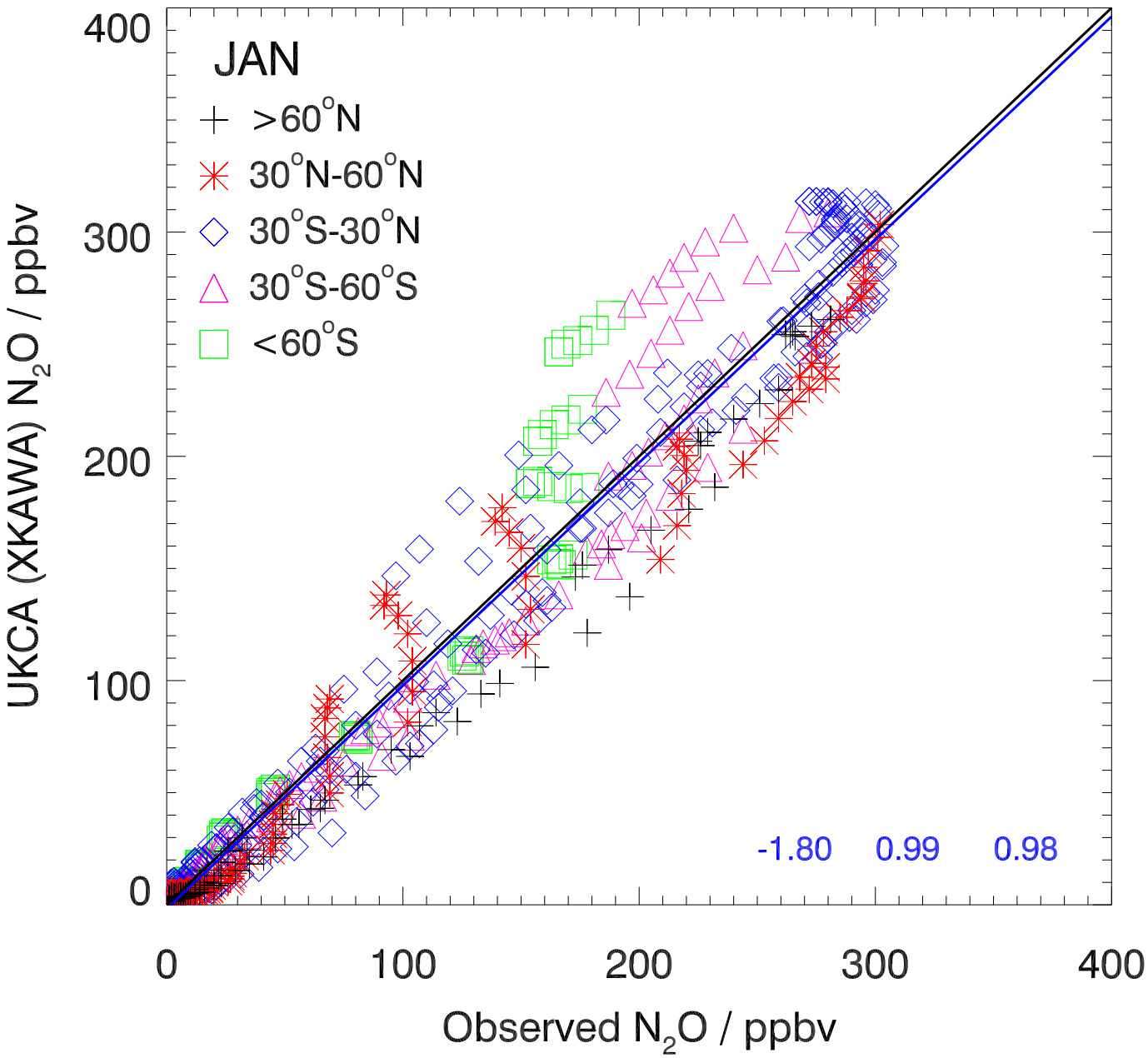

90S − 60S
60S − 30S
30S − 30N
30N − 60N
60N − 90N
Altitude /km
N2O (ppb)
xkawa
ACE
UARS
0
10
20
30
40
50
60
0
100
200
300
400

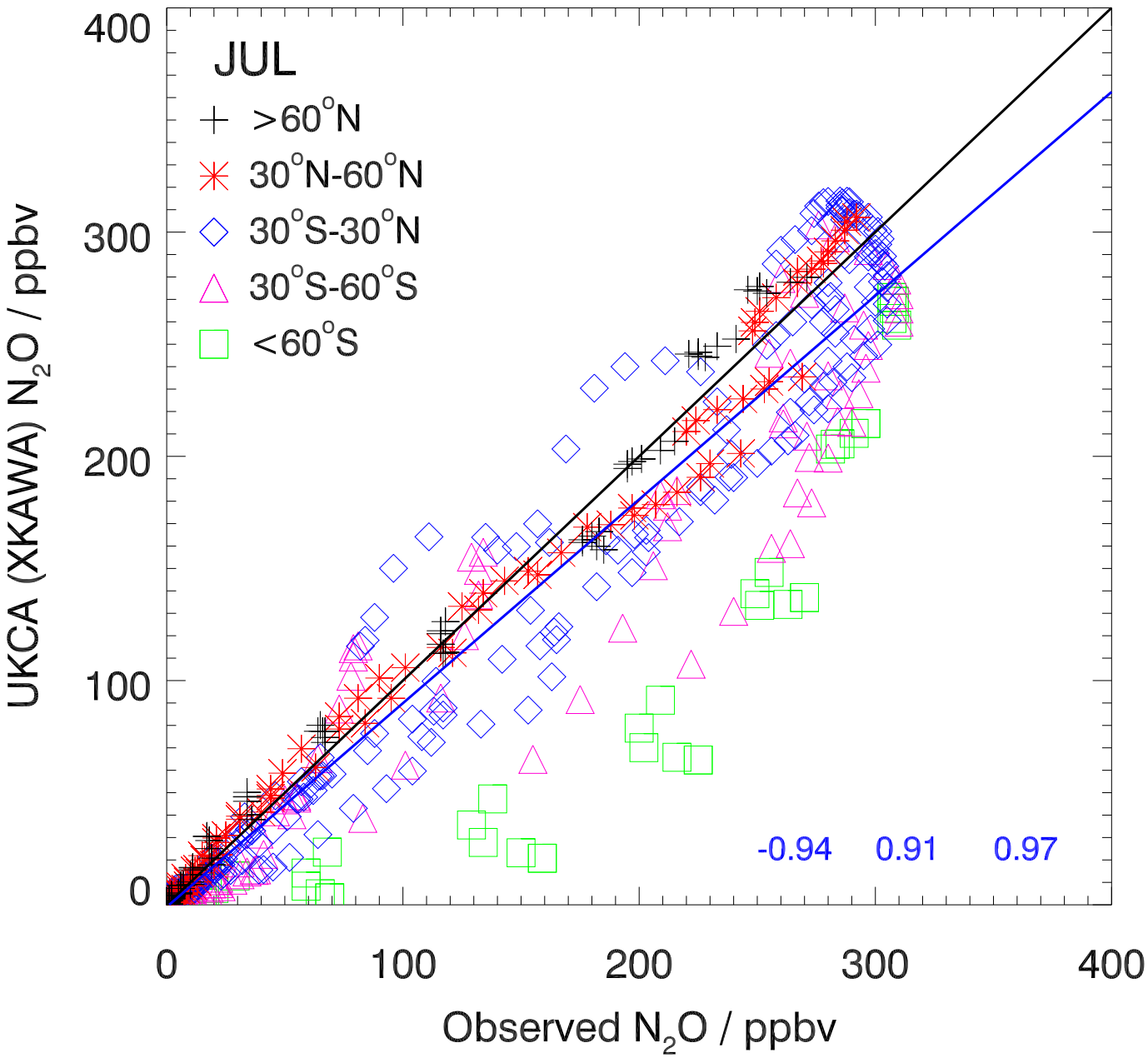

UKCA xkawa
% CH4 + OH flux (moles cm−3 s−1)
Methane lifetime = 9.13 yr
Altitude (km)
0
5
10
15
20
−50
0
50
Latitude (degrees)
0.0
0.1
0.2
0.3
0.4

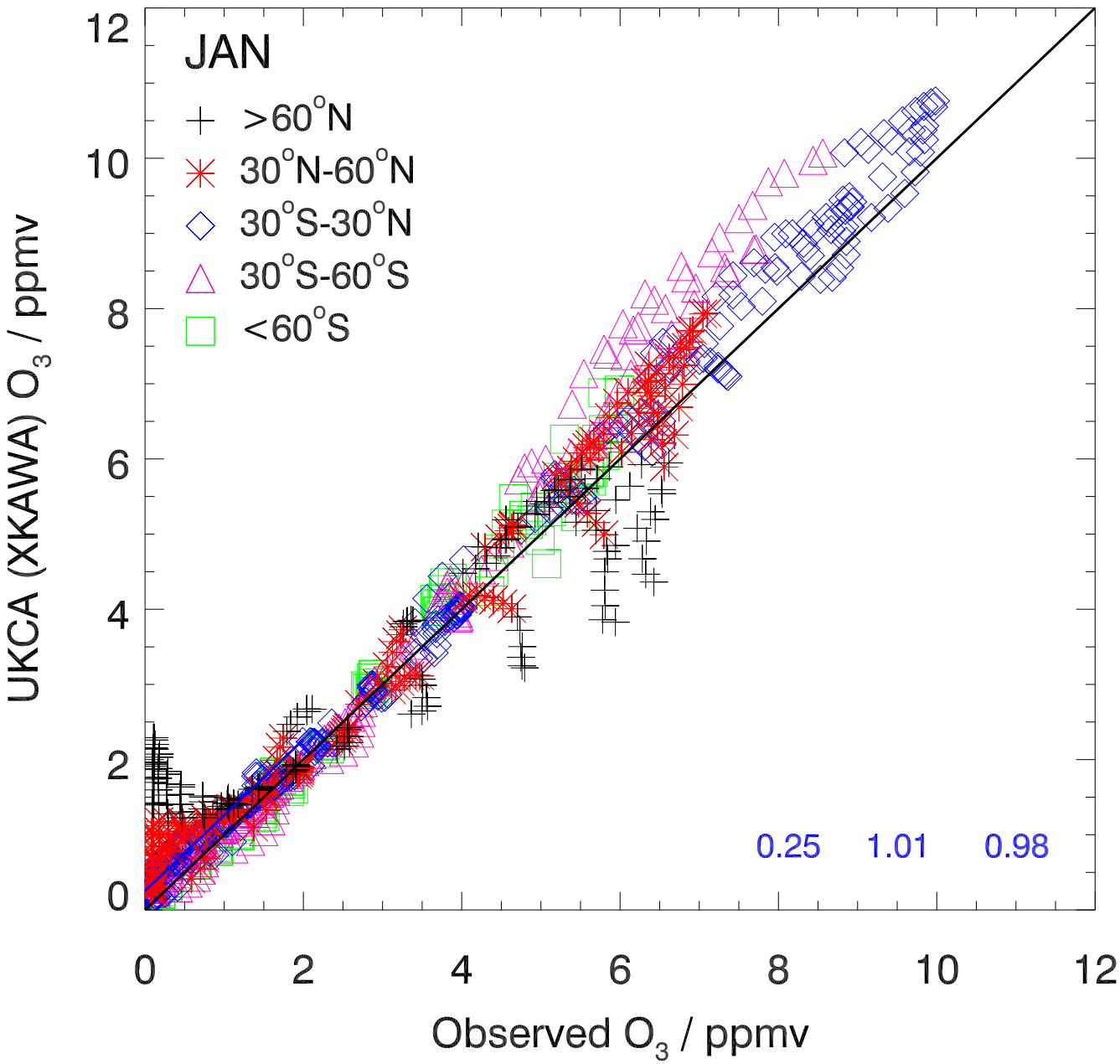

xkawa Tilmes ozone sonde comparison
South Pole
Southern Midlat
Tropics2
Tropics3
East US
Japan
West EU
Canada
North Pole East
North Pole West
Ozone (ppbv)
250 hPa
r = 0.885
mbe =−67.3 ppbv
r = 0.489
mbe =−38.5 ppbv
r = 0.661
mbe =−4.05 ppbv
r = 0.585
mbe =−17.4 ppbv
r = 0.377
mbe =−13.8 ppbv
r = 0.432
mbe =−23.1 ppbv
r = 0.822
mbe =−27 ppbv
r = 0.815
mbe =−81.4 ppbv
r = 0.863
mbe =−82.1 ppbv
r = 0.96
mbe =−151 ppbv
500 hPa
r = 0.98
mbe =−13.3 ppbv
r = 0.729
mbe =−15.8 ppbv
r = 0.9
mbe =−5.38 ppbv
r = 0.827
mbe =−18.9 ppbv
r = 0.854
mbe =−6.81 ppbv
r = 0.742
mbe =−9.21 ppbv
r = 0.936
mbe =−10.2 ppbv
r = 0.752
mbe =−8.59 ppbv
r = 0.799
mbe =−15.6 ppbv
r = 0.745
mbe =−11.5 ppbv
700 hPa
r = 0.992
mbe =−7.57 ppbv
r = 0.93
mbe =−5.24 ppbv
r = 0.721
mbe =10.5 ppbv
r = 0.928
mbe =8.45 ppbv
r = 0.865
mbe =−3.04 ppbv
r = 0.585
mbe =−3.69 ppbv
r = 0.853
mbe =3.1 ppbv
r = 0.204
mbe =6.41 ppbv
r = 0.476
mbe =−4.86 ppbv
r = 0.281
mbe =1.15 ppbv
900 hPa
r = 0.99
mbe =−10.2 ppbv
r = 0.984
mbe =−9.36 ppbv
r = 0.401
mbe =6.39 ppbv
r = 0.764
mbe =1.68 ppbv
r = 0.938
mbe =−10.9 ppbv
r = 0.762
mbe =−10.8 ppbv
r = 0.891
mbe =−6.7 ppbv
r = −0.18
mbe =−7.04 ppbv
r = −0.211
mbe =−15.8 ppbv
r = −0.656
mbe =−9.25 ppbv
Jan
May
Sep

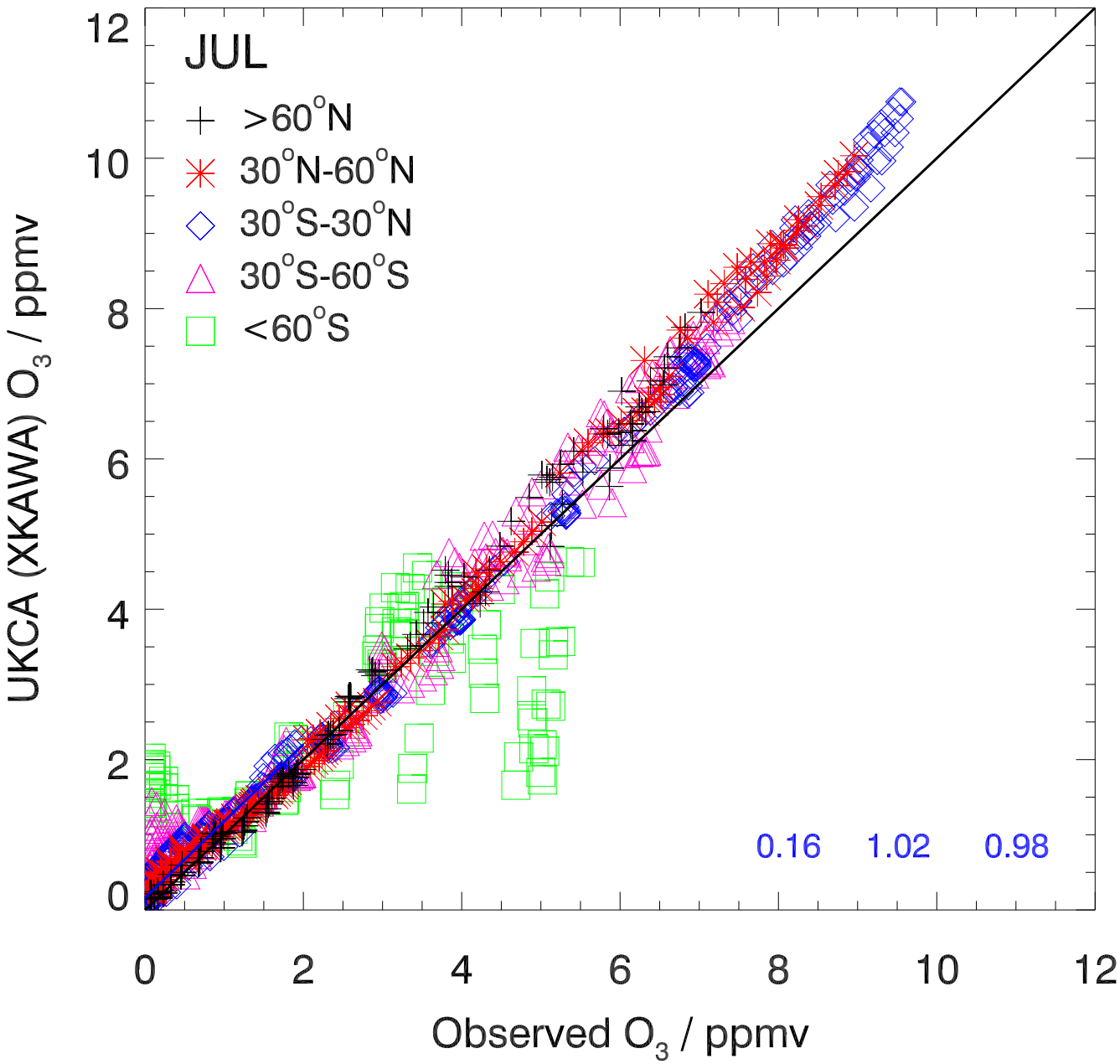

JAN
>60°N
30°N-60°N
30°S-30°N
30°S-60°S
<60°S
0.02
0.99
0.99
UKCA (XKAWA) CH4 / ppmv
Observed (HALOE) CH4 / ppmv
0.0
0.5
1.0
1.5
2.0

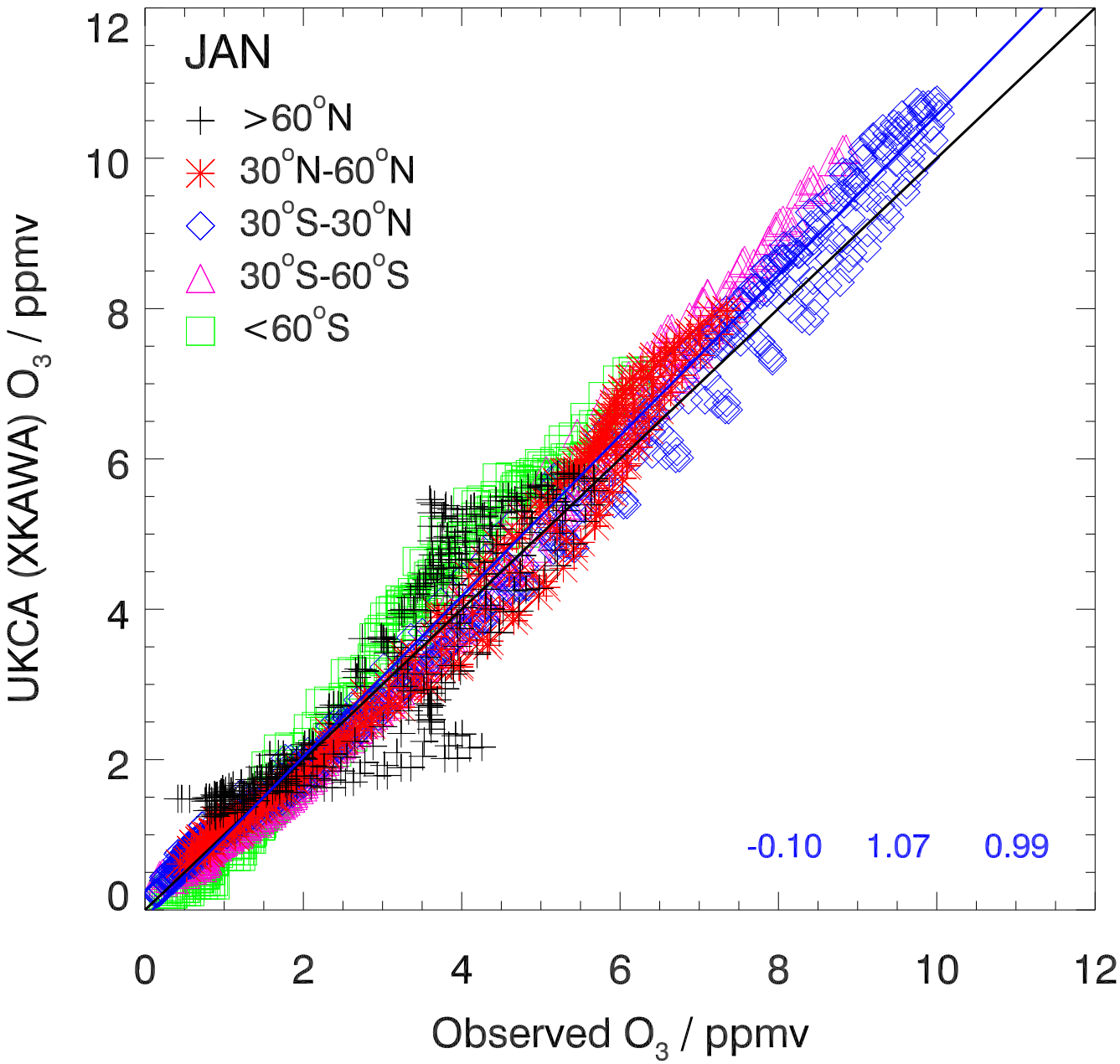

JUL
>60°N
30°N-60°N
30°S-30°N
30°S-60°S
<60°S
-0.01
1.02
0.99
UKCA (XKAWA) CH4 / ppmv
Observed (HALOE) CH4 / ppmv
0.0
0.5
1.0
1.5
2.0

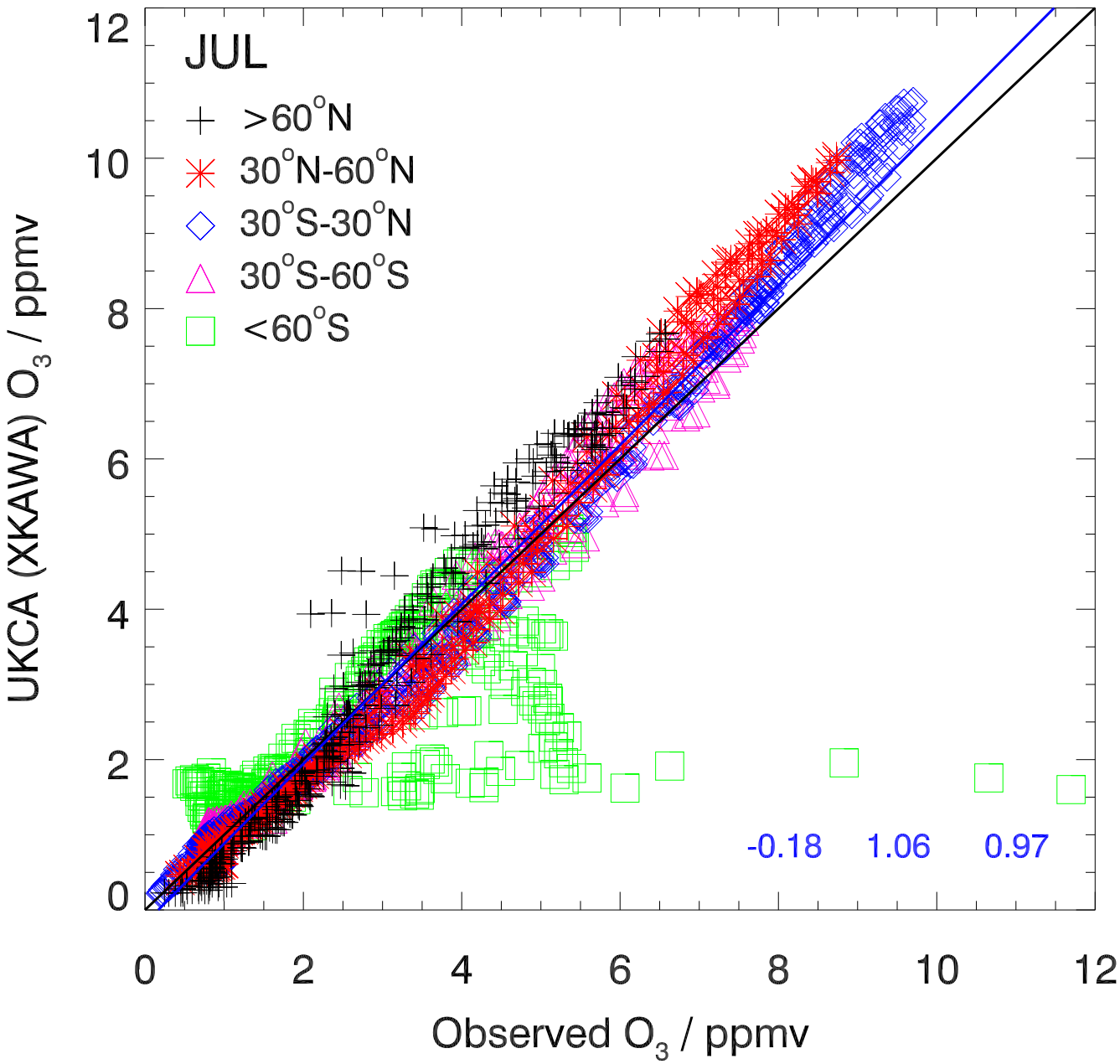

JAN
>60°N
30°N-60°N
30°S-30°N
30°S-60°S
<60°S
-1.80
0.99
0.98
UKCA (XKAWA) N2O / ppbv
Observed N2O / ppbv
0
100
200
300
400

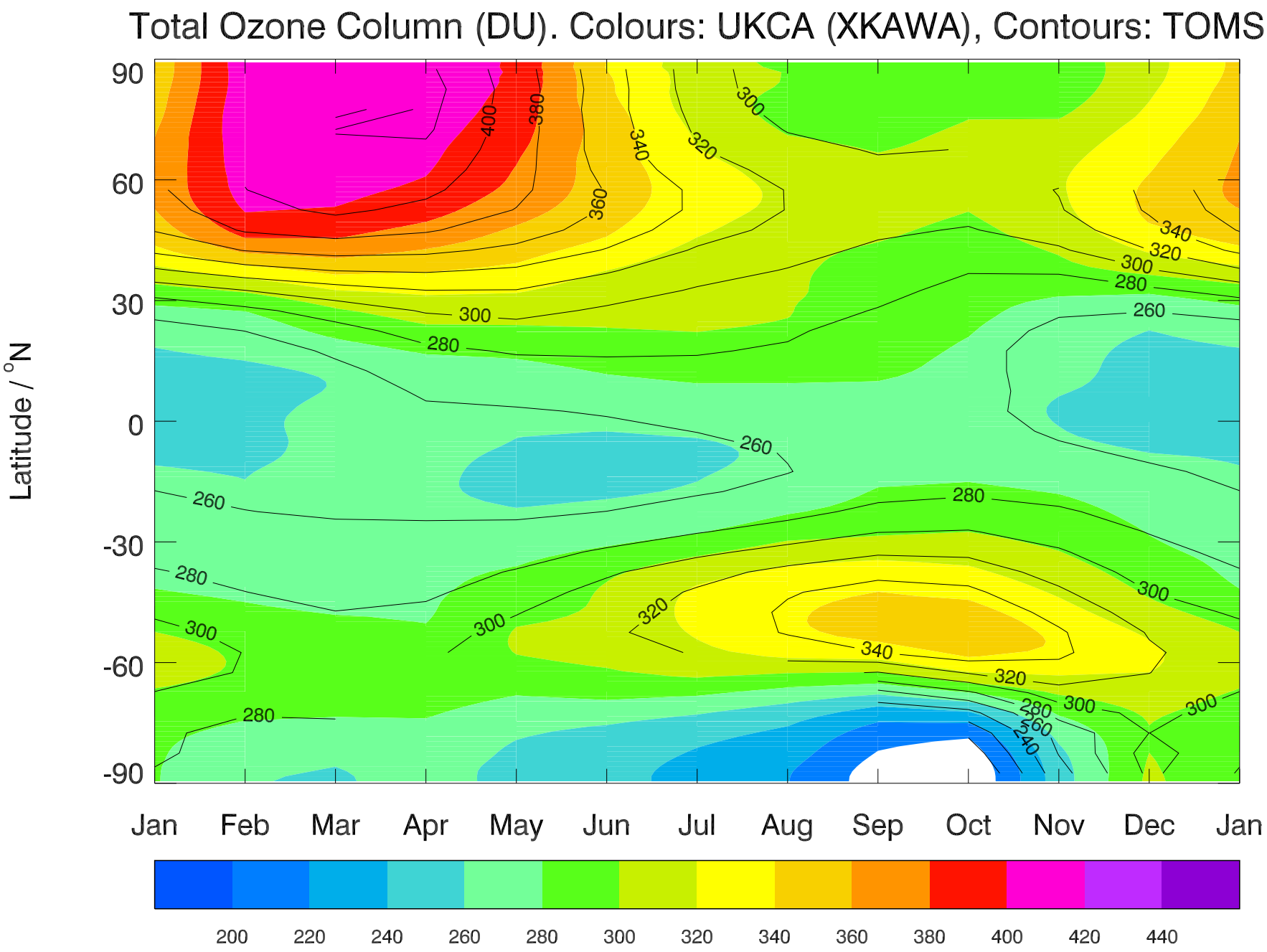

JUL
>60°N
30°N-60°N
30°S-30°N
30°S-60°S
<60°S
-0.94
0.91
0.97
UKCA (XKAWA) N2O / ppbv
Observed N2O / ppbv
0
100
200
300
400

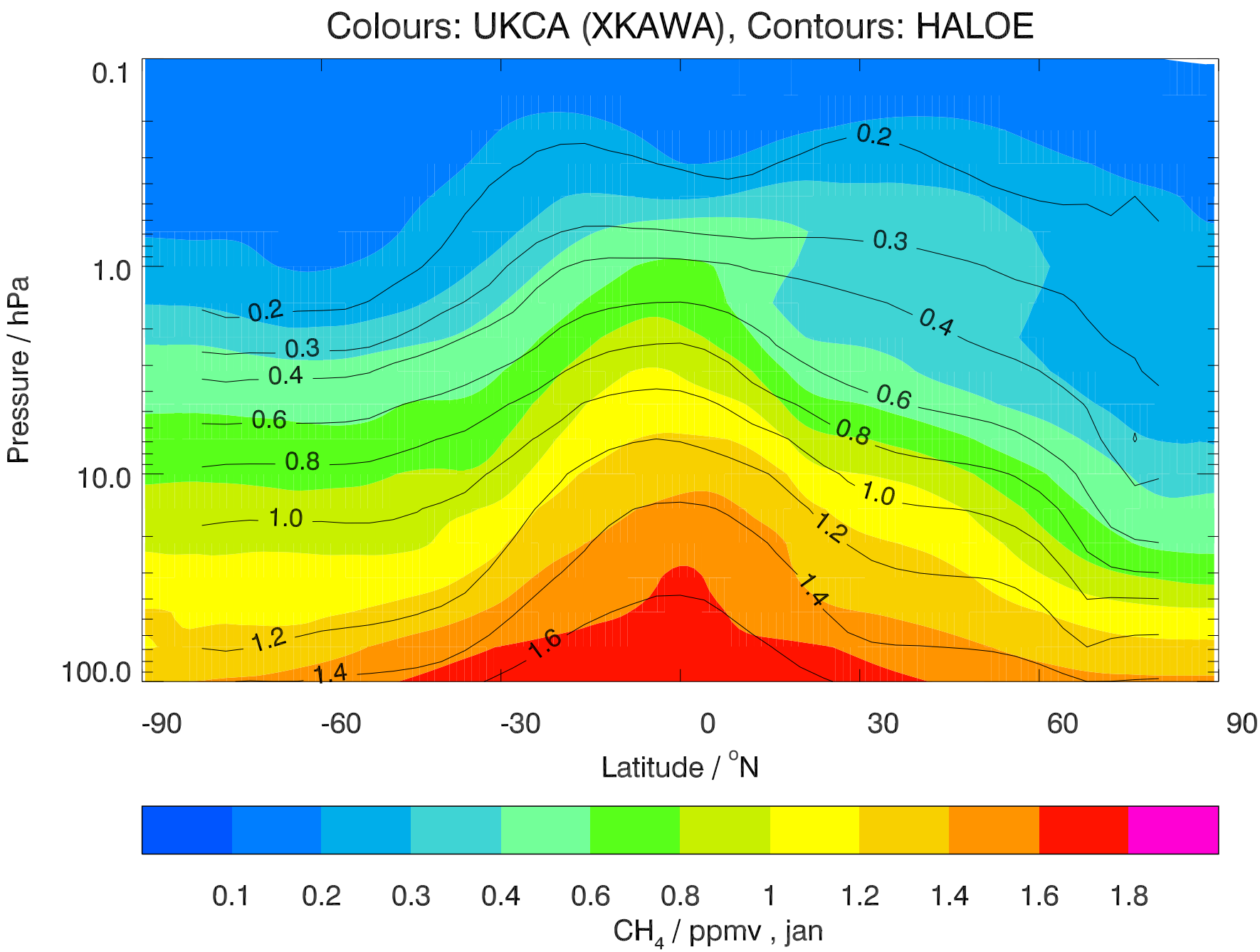

JAN
>60°N
30°N-60°N
30°S-30°N
30°S-60°S
<60°S
0.25
1.01
0.98
UKCA (XKAWA) O3 / ppmv
Observed O3 / ppmv
0
2
4
6
8
10
12

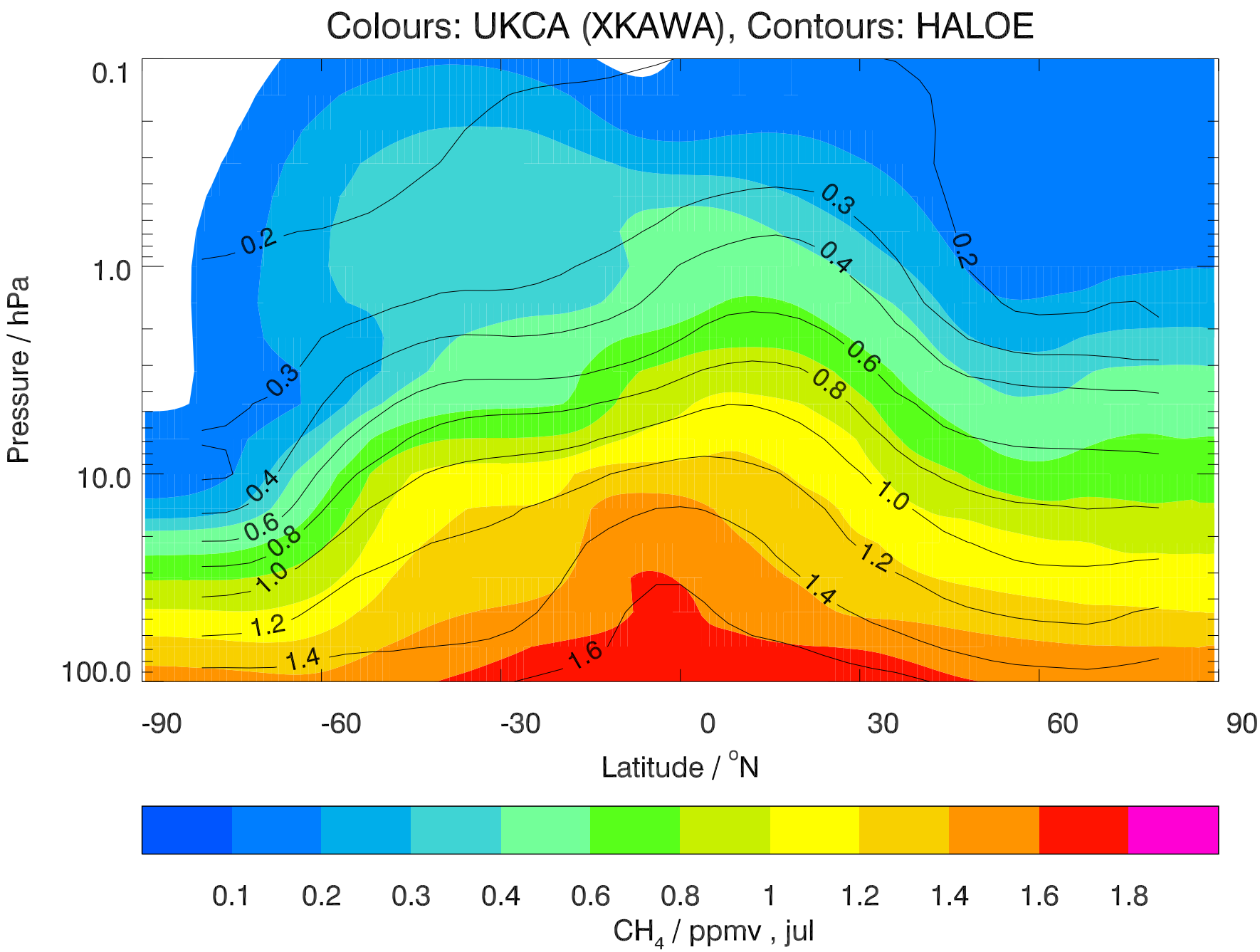

JUL
>60°N
30°N-60°N
30°S-30°N
30°S-60°S
<60°S
0.16
1.02
0.98
UKCA (XKAWA) O3 / ppmv
Observed O3 / ppmv
0
2
4
6
8
10
12

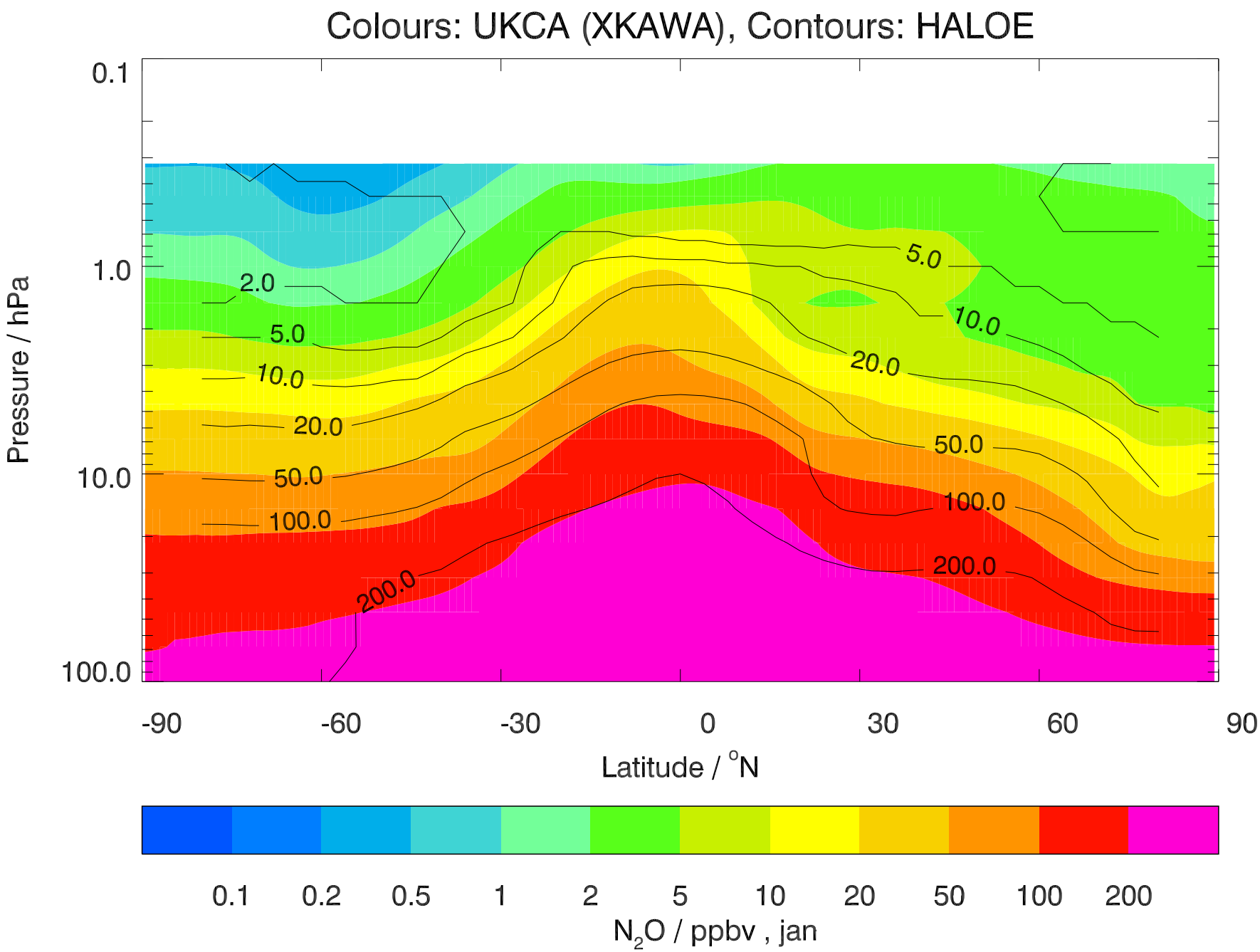

JAN
>60°N
30°N-60°N
30°S-30°N
30°S-60°S
<60°S
-0.10
1.07
0.99
UKCA (XKAWA) O3 / ppmv
Observed O3 / ppmv
0
2
4
6
8
10
12

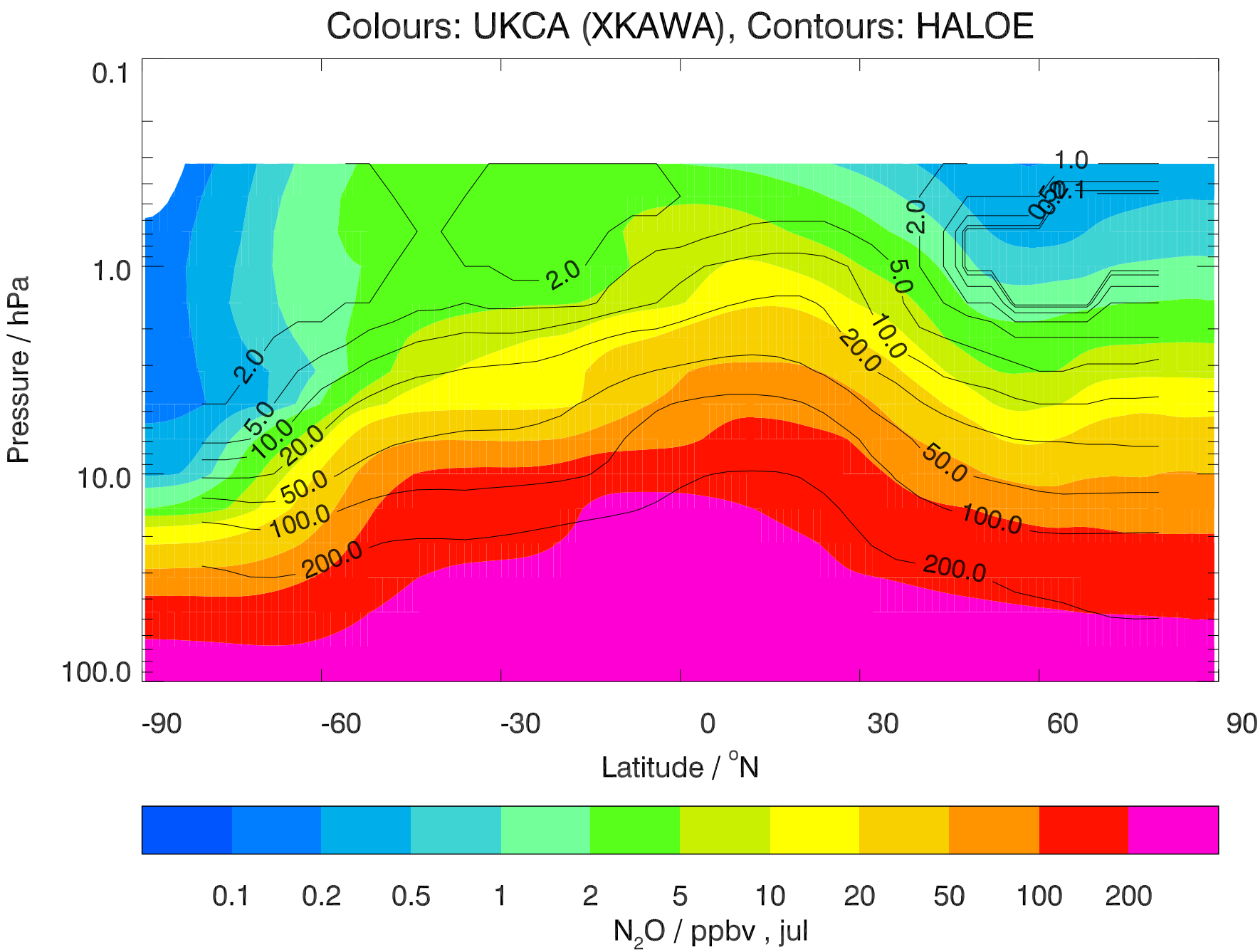

JUL
>60°N
30°N-60°N
30°S-30°N
30°S-60°S
<60°S
-0.18
1.06
0.97
UKCA (XKAWA) O3 / ppmv
Observed O3 / ppmv
0
2
4
6
8
10
12

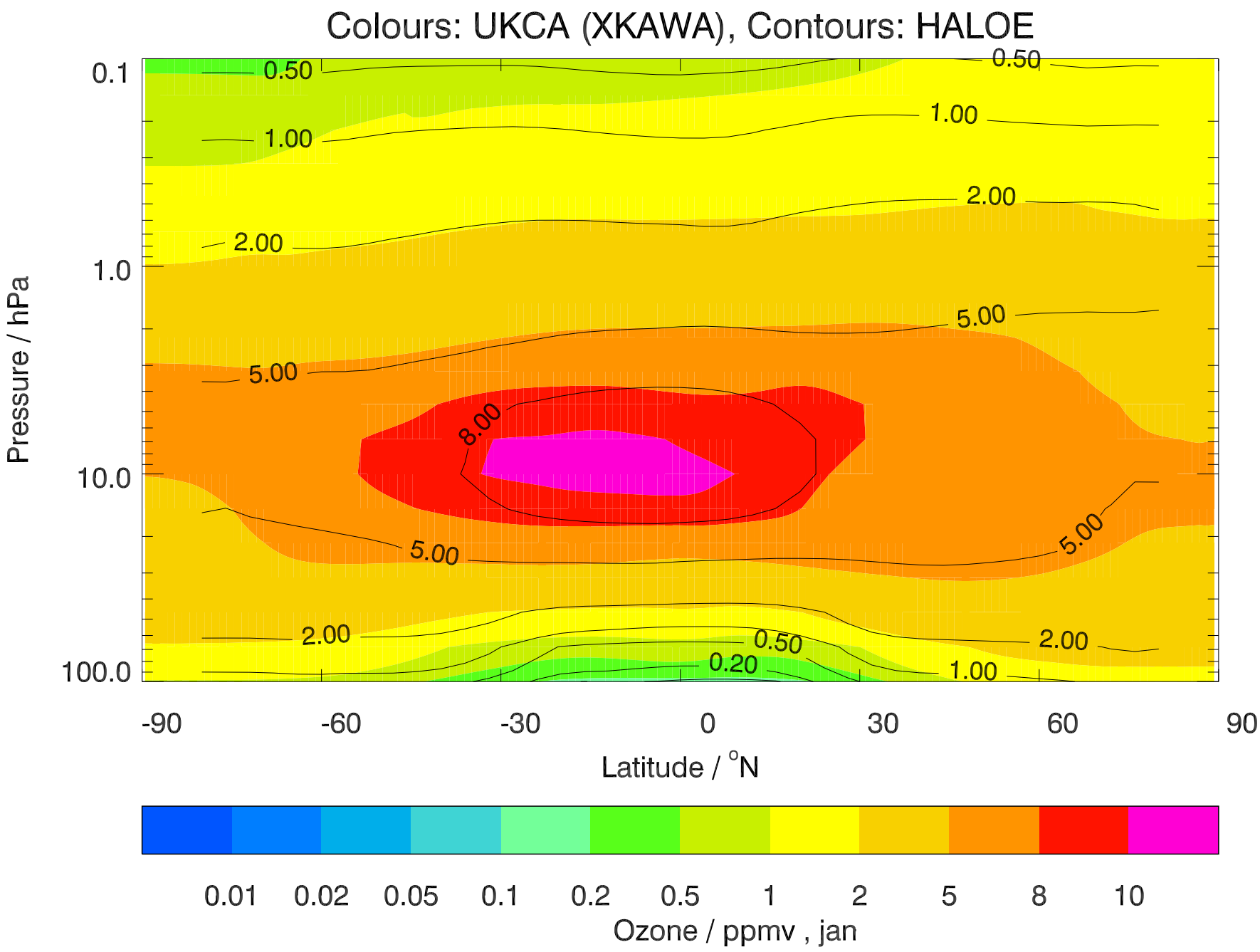

Total Ozone Column (DU). Colours: UKCA (XKAWA), Contours: TOMS
Latitude / °N
90
60
30
0
-30
-60
-90
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Jan
200
220
240
260
280
300
320
340
360
380
400
420
440

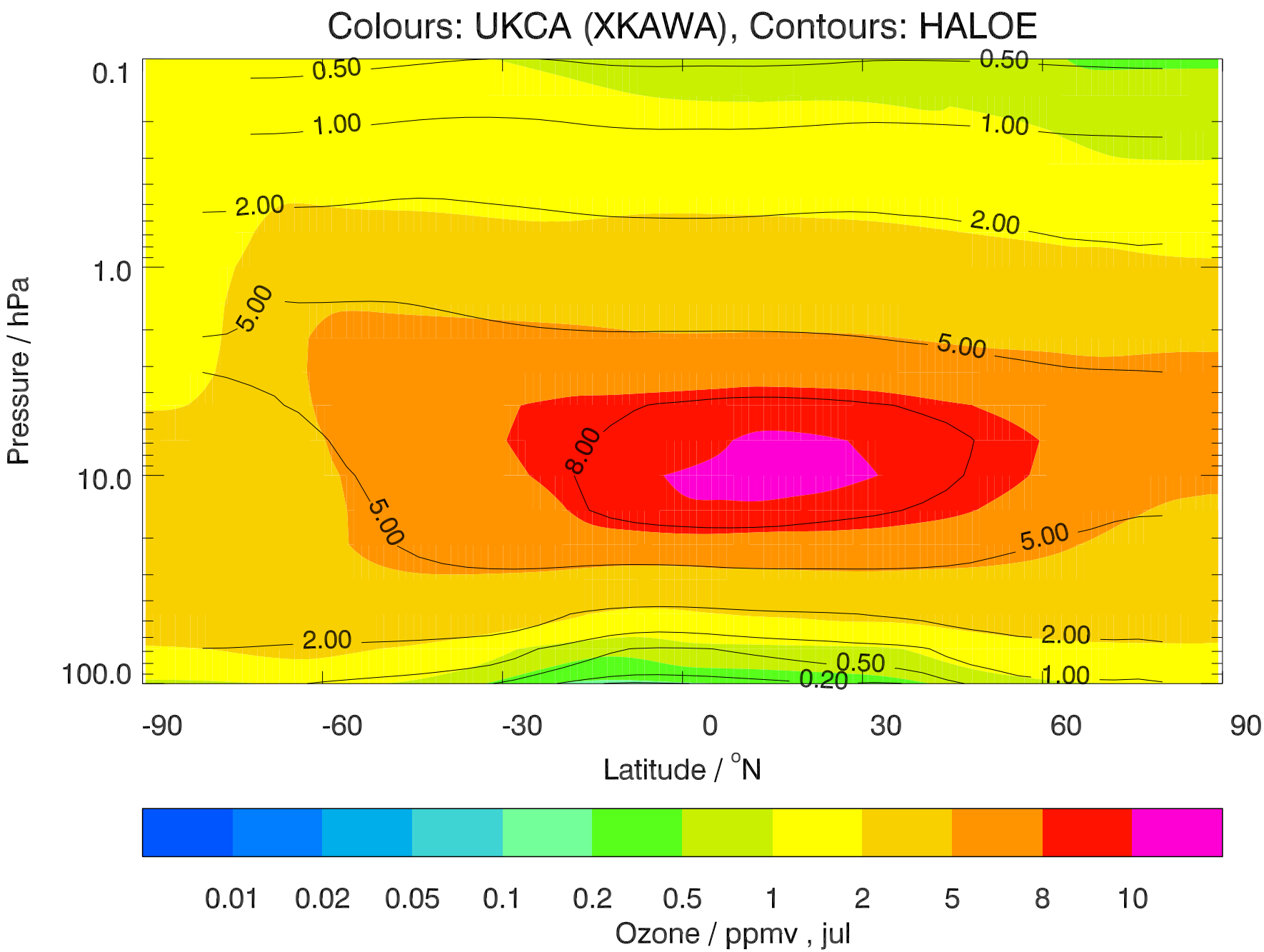

Colours: UKCA (XKAWA), Contours: HALOE
Pressure / hPa
0.1
1.0
10.0
100.0
0.2
0.3
0.4
0.6
0.8
1.0
1.2
1.4
1.6
-90
-60
-30
0
30
60
90
Latitude / °N
0.1
0.2
0.3
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
CH4 / ppmv , jan

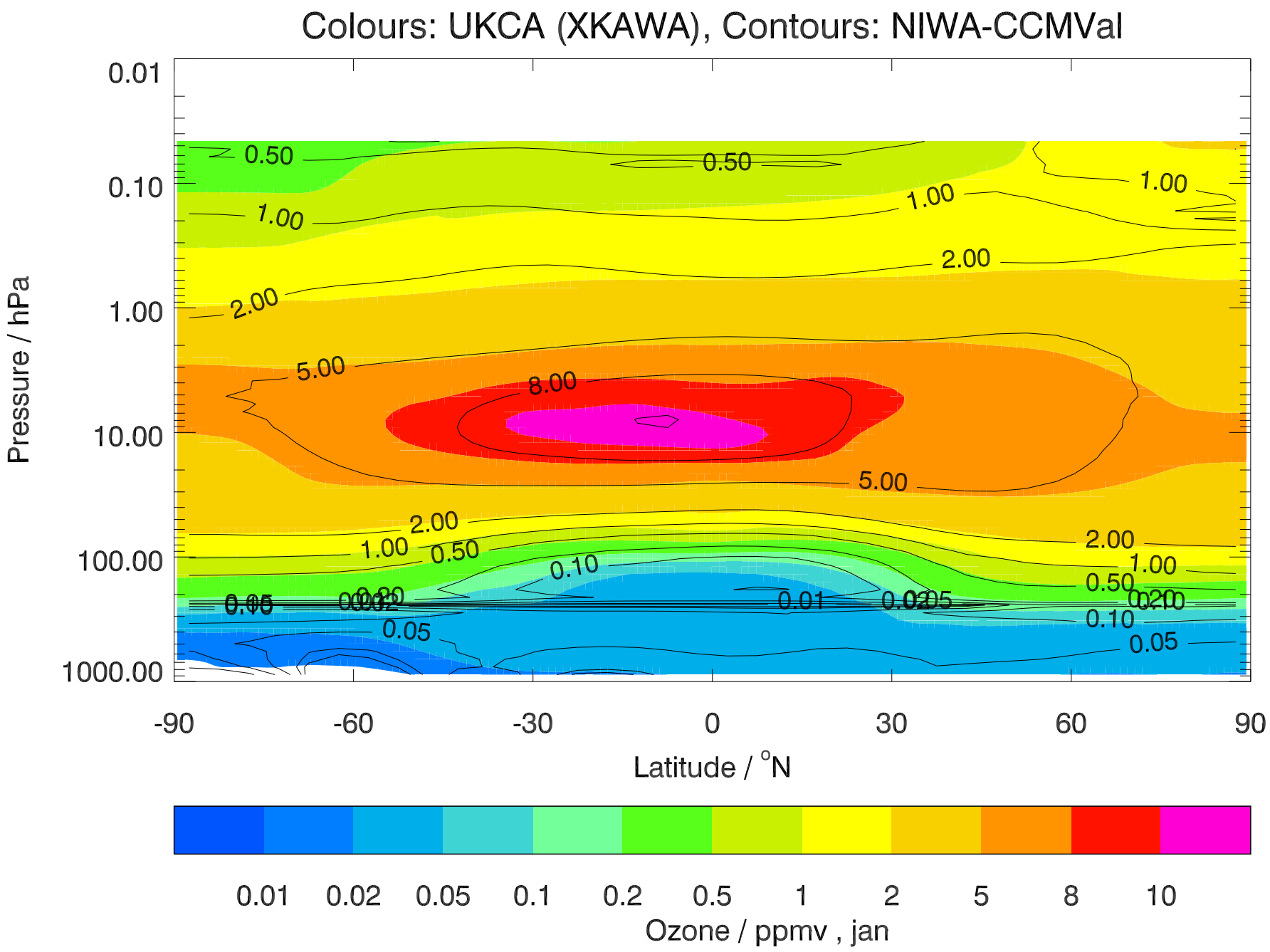

Colours: UKCA (XKAWA), Contours: HALOE
Pressure / hPa
0.1
1.0
10.0
100.0
-90
-60
-30
0
30
60
90
Latitude / °N
0.2
0.3
0.4
0.6
0.8
1.0
1.2
1.4
1.6
0.1
0.2
0.3
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
CH4 / ppmv , jul

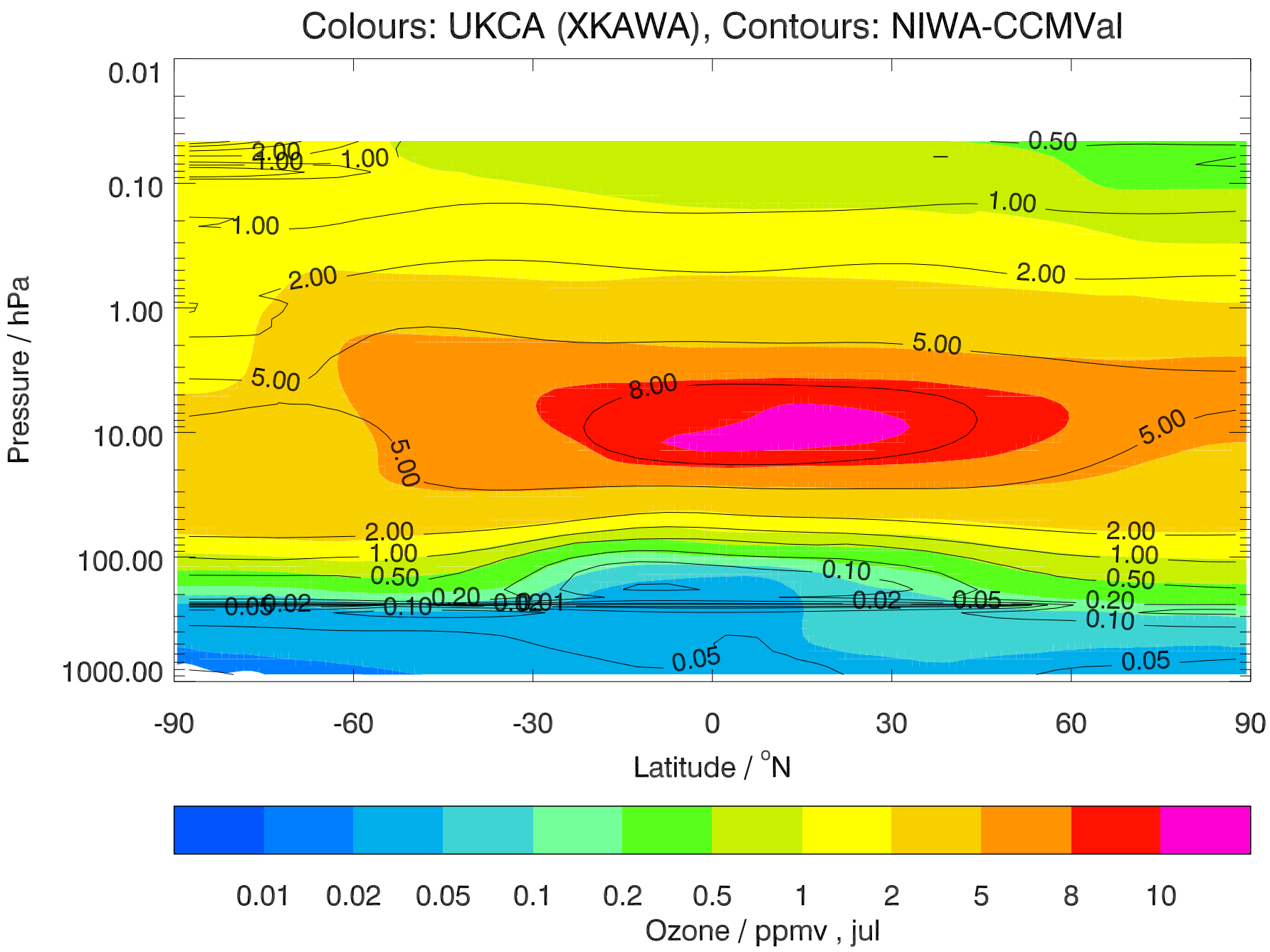

Colours: UKCA (XKAWA), Contours: HALOE
Pressure / hPa
0.1
1.0
10.0
100.0
2.0
5.0
10.0
20.0
50.0
100.0
200.0
-90
-60
-30
0
30
60
90
Latitude / °N
0.1
0.2
0.5
1
2
5
10
20
50
100
200
N2O / ppbv , jan

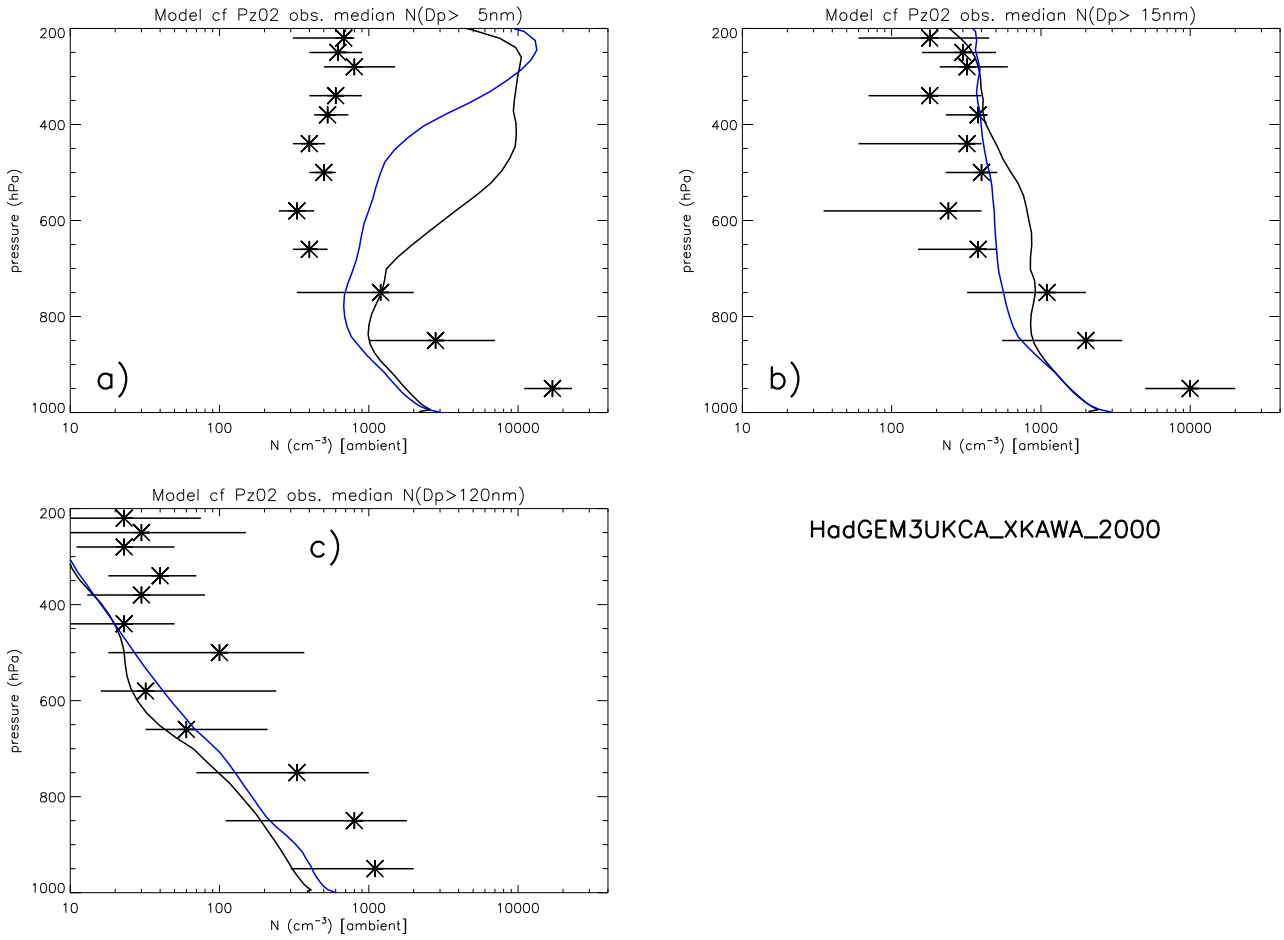

Colours: UKCA (XKAWA), Contours: HALOE
Pressure / hPa
0.1
1.0
10.0
100.0
-90
-60
-30
0
30
60
90
Latitude / °N
2.0
5.0
10.0
20.0
50.0
100.0
200.0
1.0
0.5
0.1
0.1
0.2
0.5
1
2
5
10
20
50
100
200
N2O / ppbv , jul

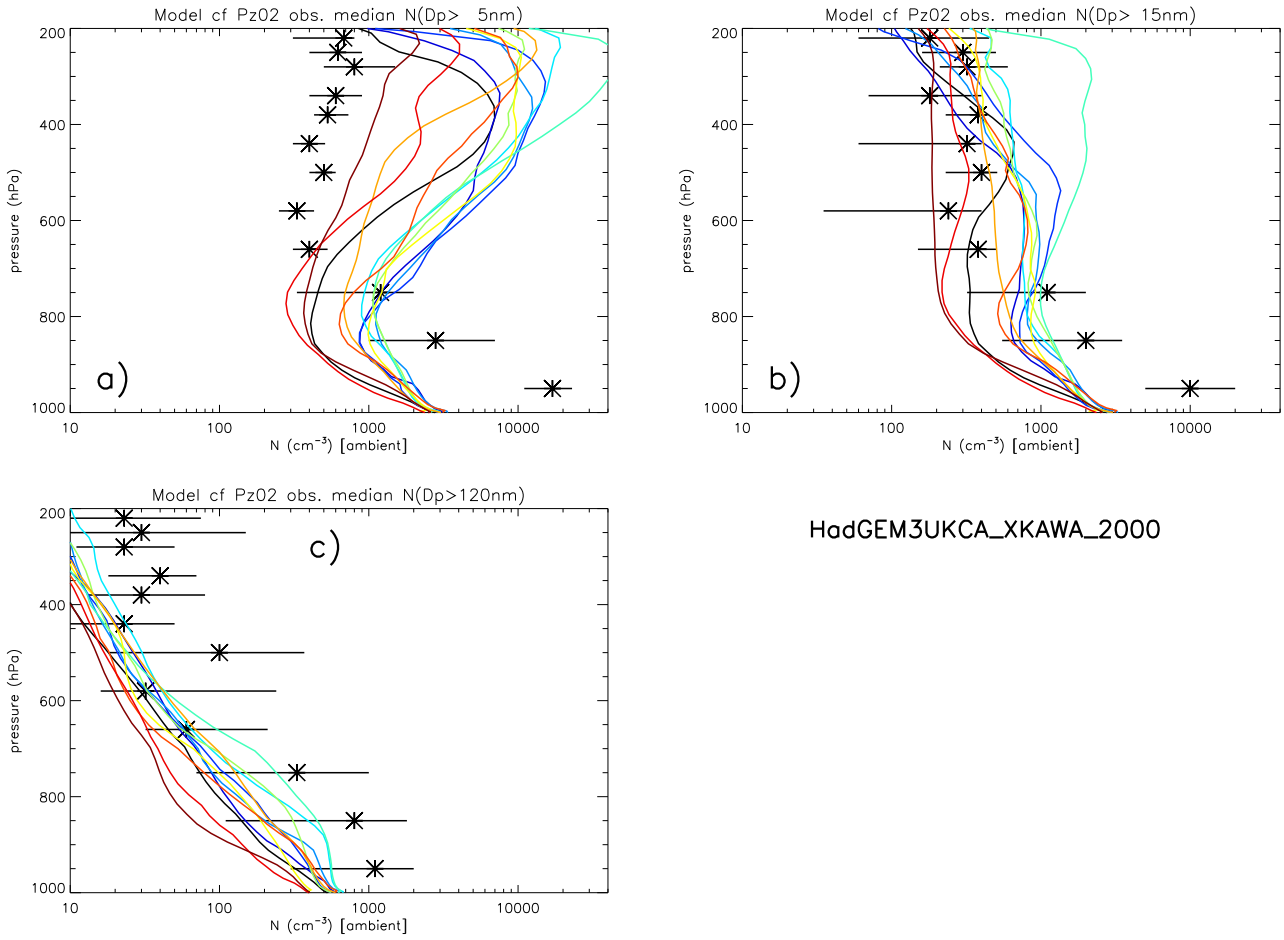

Colours: UKCA (XKAWA), Contours: HALOE
Pressure / hPa
0.1
1.0
10.0
100.0
0.50
1.00
2.00
5.00
8.00
0.20
-90
-60
-30
0
30
60
90
Latitude / °N
0.01
0.02
0.05
0.1
0.2
0.5
1
2
5
8
10
Ozone / ppmv , jan

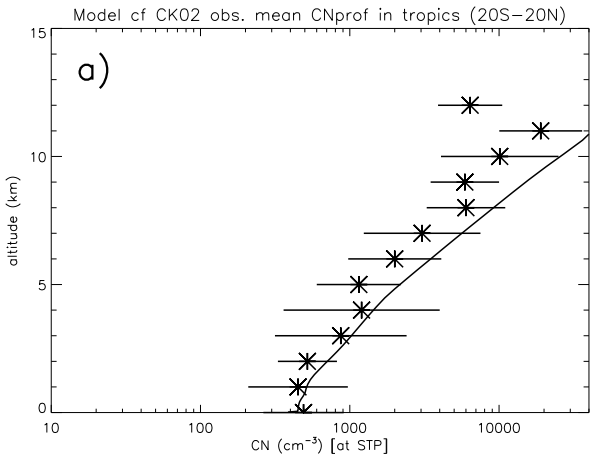

Colours: UKCA (XKAWA), Contours: HALOE
Pressure / hPa
0.1
1.0
10.0
100.0
0.50
1.00
2.00
5.00
8.00
0.20
-90
-60
-30
0
30
60
90
Latitude / °N
0.01
0.02
0.05
0.1
0.2
0.5
1
2
5
8
10
Ozone / ppmv , jul

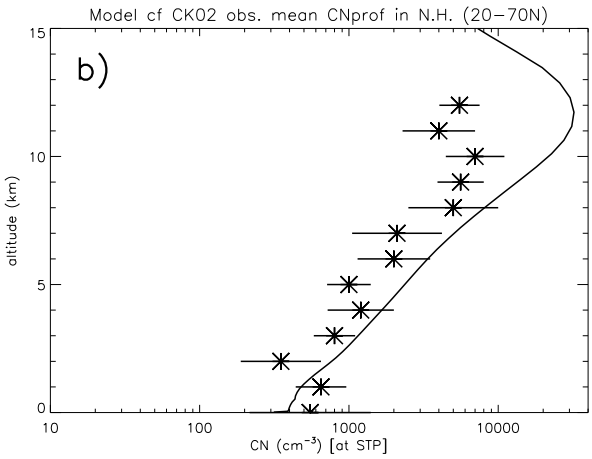

Colours: UKCA (XKAWA), Contours: NIWA-CCMVal
Pressure / hPa
0.01
0.10
1.00
10.00
100.00
1000.00
-90
-60
-30
0
30
60
90
Latitude / °N
0.50
1.00
2.00
5.00
8.00
0.10
0.05
0.01
0.02
0.01
0.02
0.05
0.1
0.2
0.5
1
2
5
8
10
Ozone / ppmv , jan

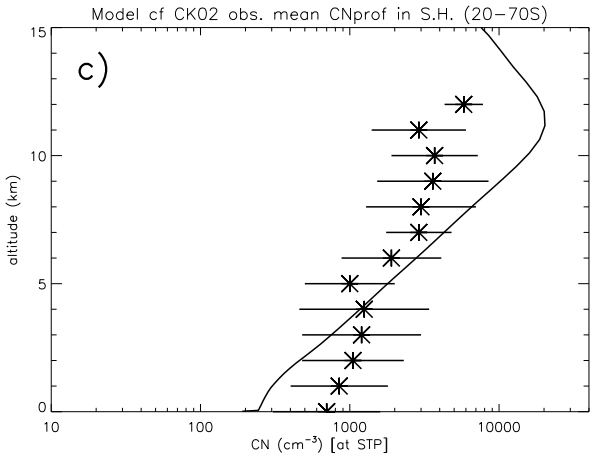

Colours: UKCA (XKAWA), Contours: NIWA-CCMVal
Pressure / hPa
0.01
0.10
1.00
10.00
100.00
1000.00
-90
-60
-30
0
30
60
90
Latitude / °N
0.01
0.02
0.05
0.1
0.2
0.5
1
2
5
8
10
Ozone / ppmv , jul


Model cf Pz02 obs. median N(Dp> 5nm)
a)
Model cf Pz02 obs. median N(Dp> 15nm)
b)
Model cf Pz02 obs. median N(Dp>120nm)
c)
pressure (hPa)
N (cm$^{-3}$) [ambient]
200
400
600
800
1000
10
100
1000
10000
HadGEM3UKCA_XKAWA_2000

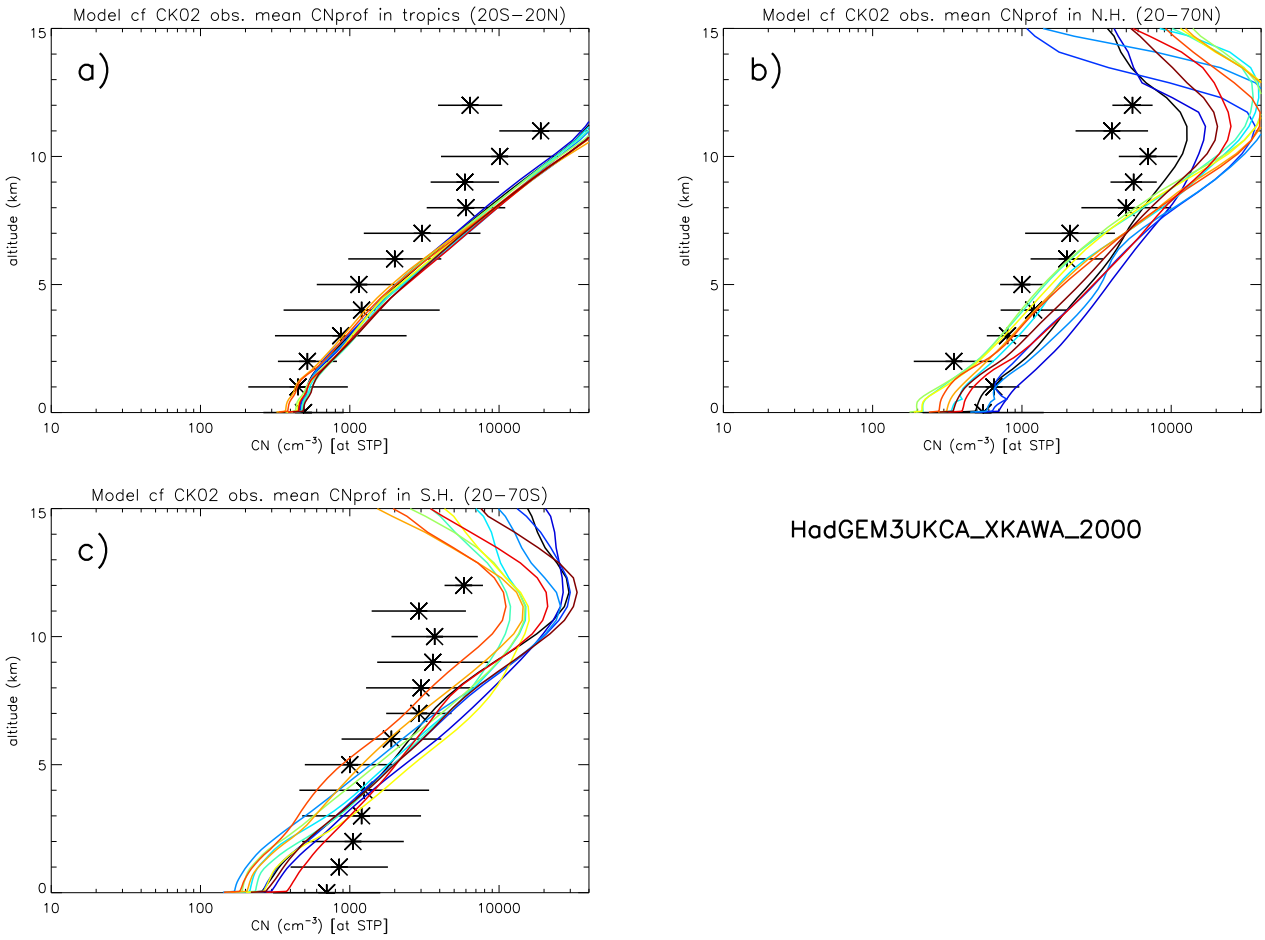

Model cf Pz02 obs. median N(Dp> 5nm)
Model cf Pz02 obs. median N(Dp> 15nm)
Model cf Pz02 obs. median N(Dp>120nm)
a)
b)
c)
pressure (hPa)
N (cm$^{-3}$) [ambient]
200
400
600
800
1000
10
100
1000
10000
HadGEM3UKCA_XKAWA_2000



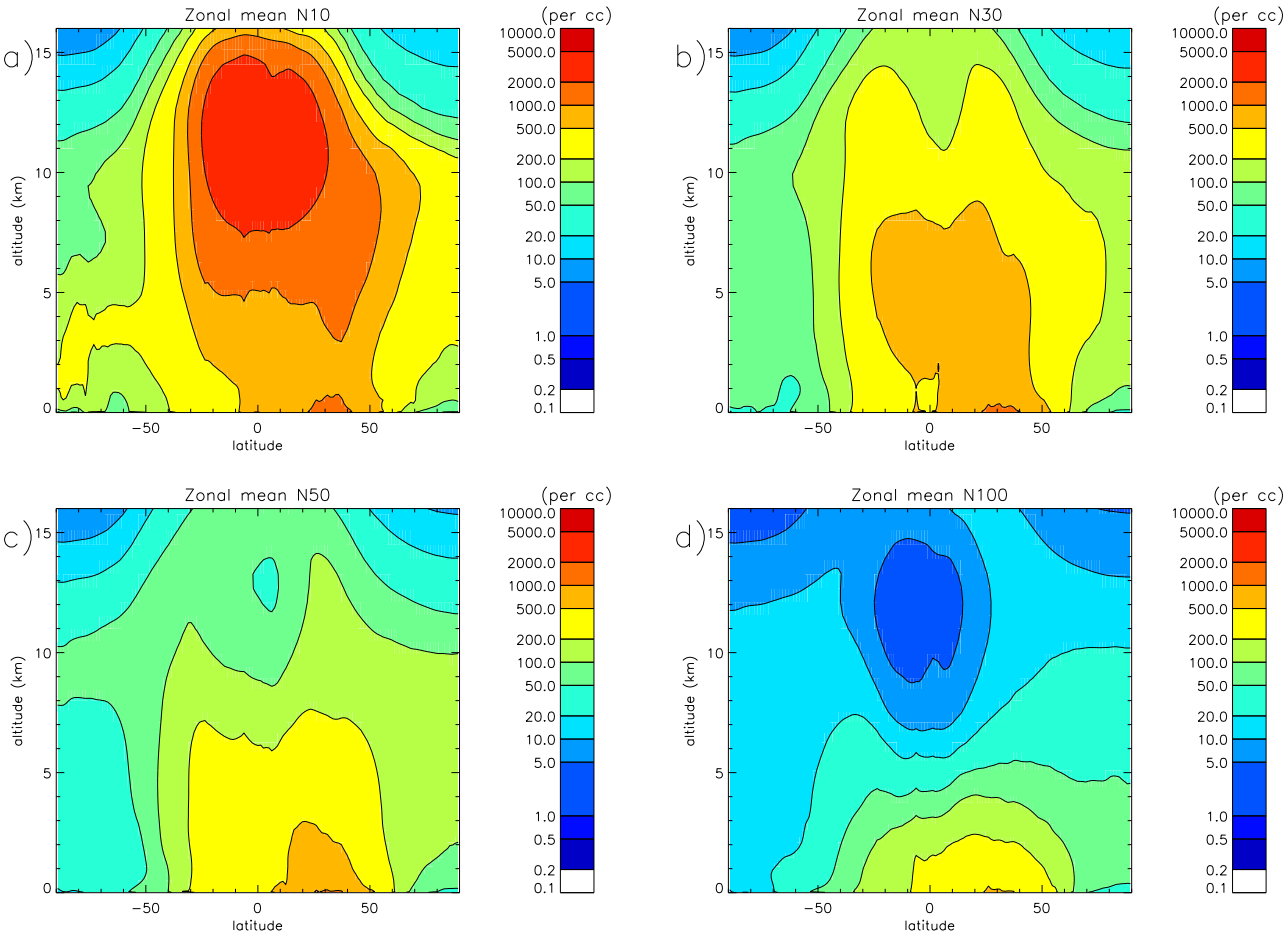



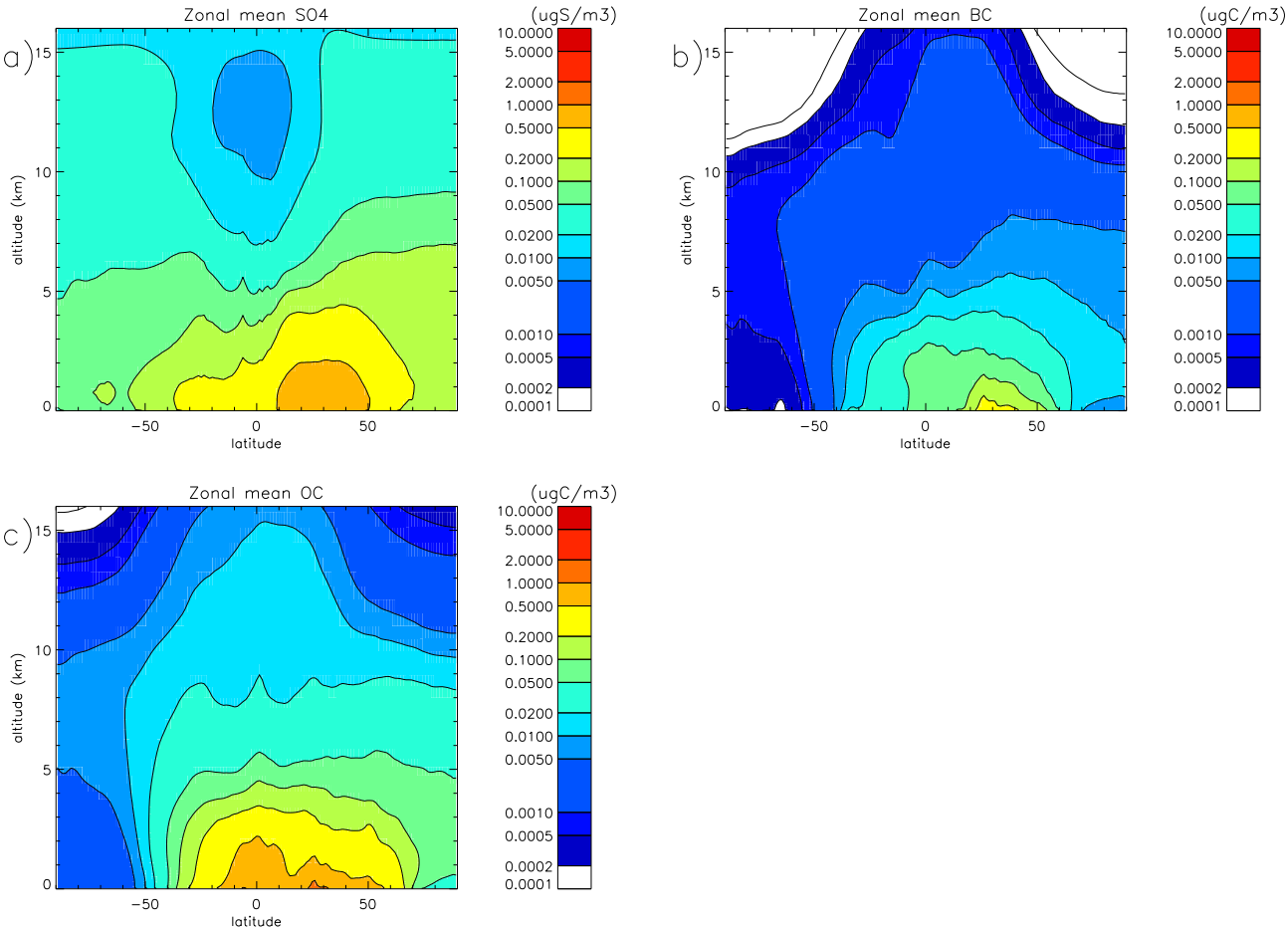

HadGEM3UKCA_XKAWA_2000


Model cf CK02 obs. mean CNprof in tropics (20S−20N)
a)
Model cf CK02 obs. mean CNprof in N.H. (20−70N)
b)
Model cf CK02 obs. mean CNprof in S.H. (20−70S)
c)
altitude (km)
CN (cm$^{-3}$) [at STP]
HadGEM3UKCA_XKAWA_2000

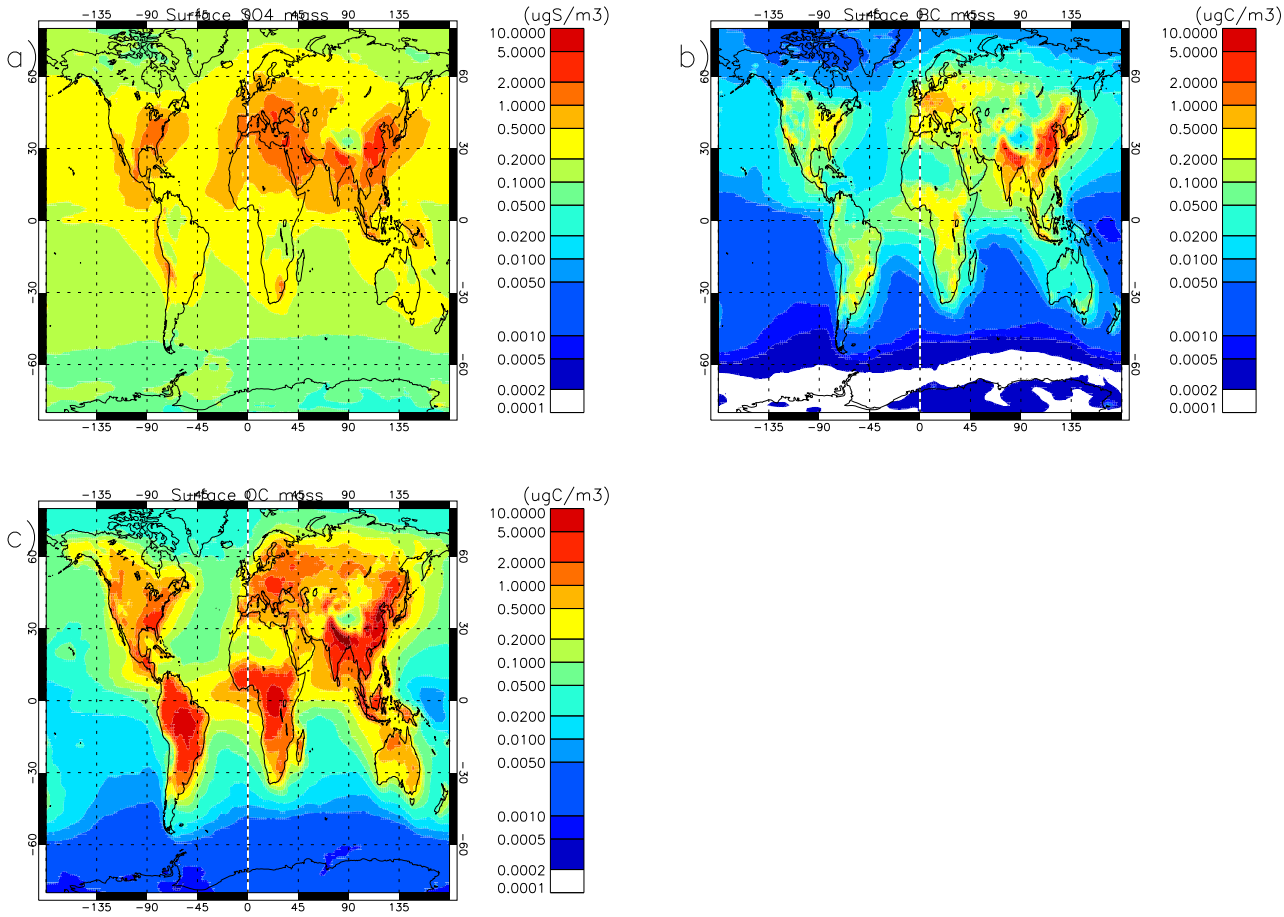
# HadGEM3UKCA_XKAWA_2000



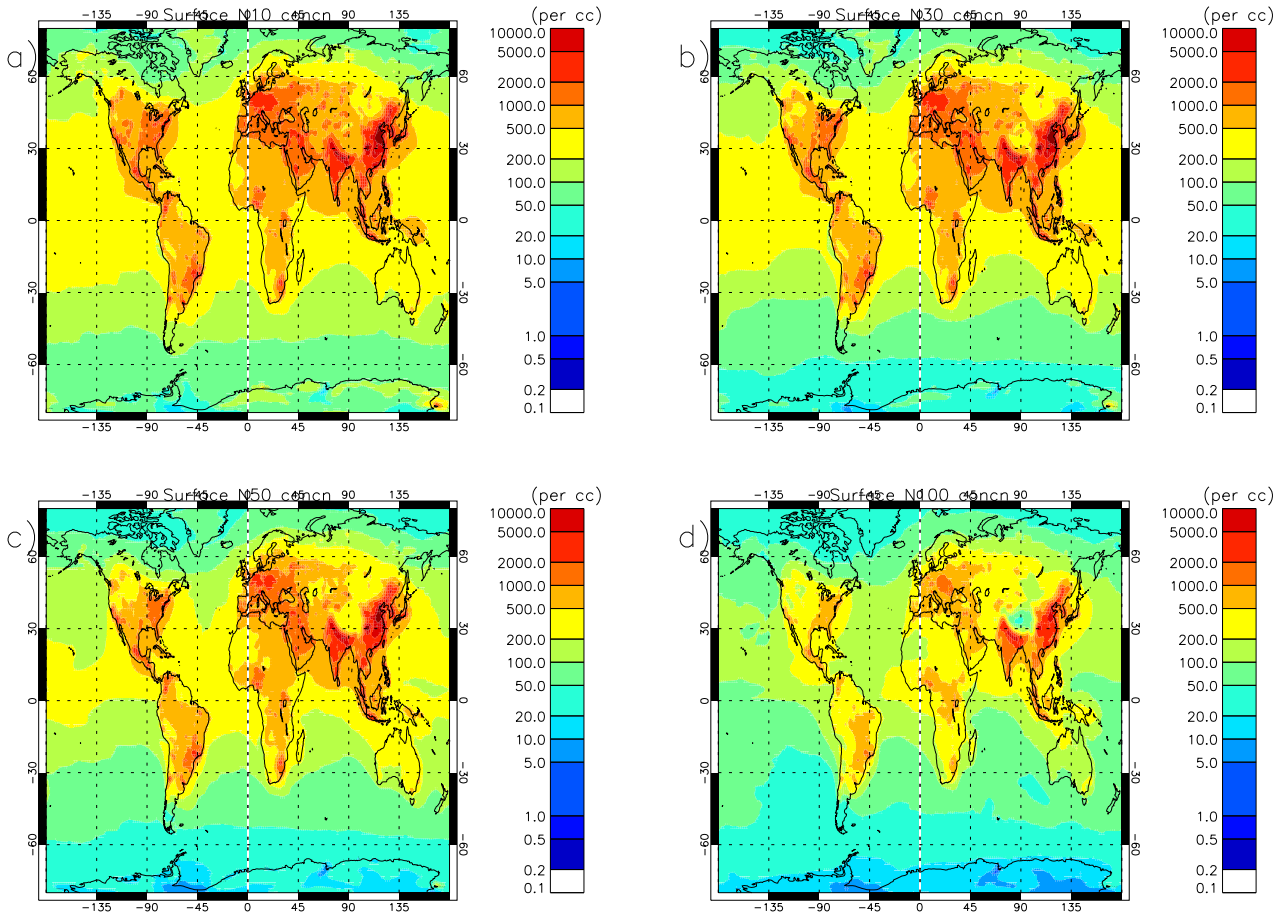
# HadGEM3UKCA_XKAWA_2000

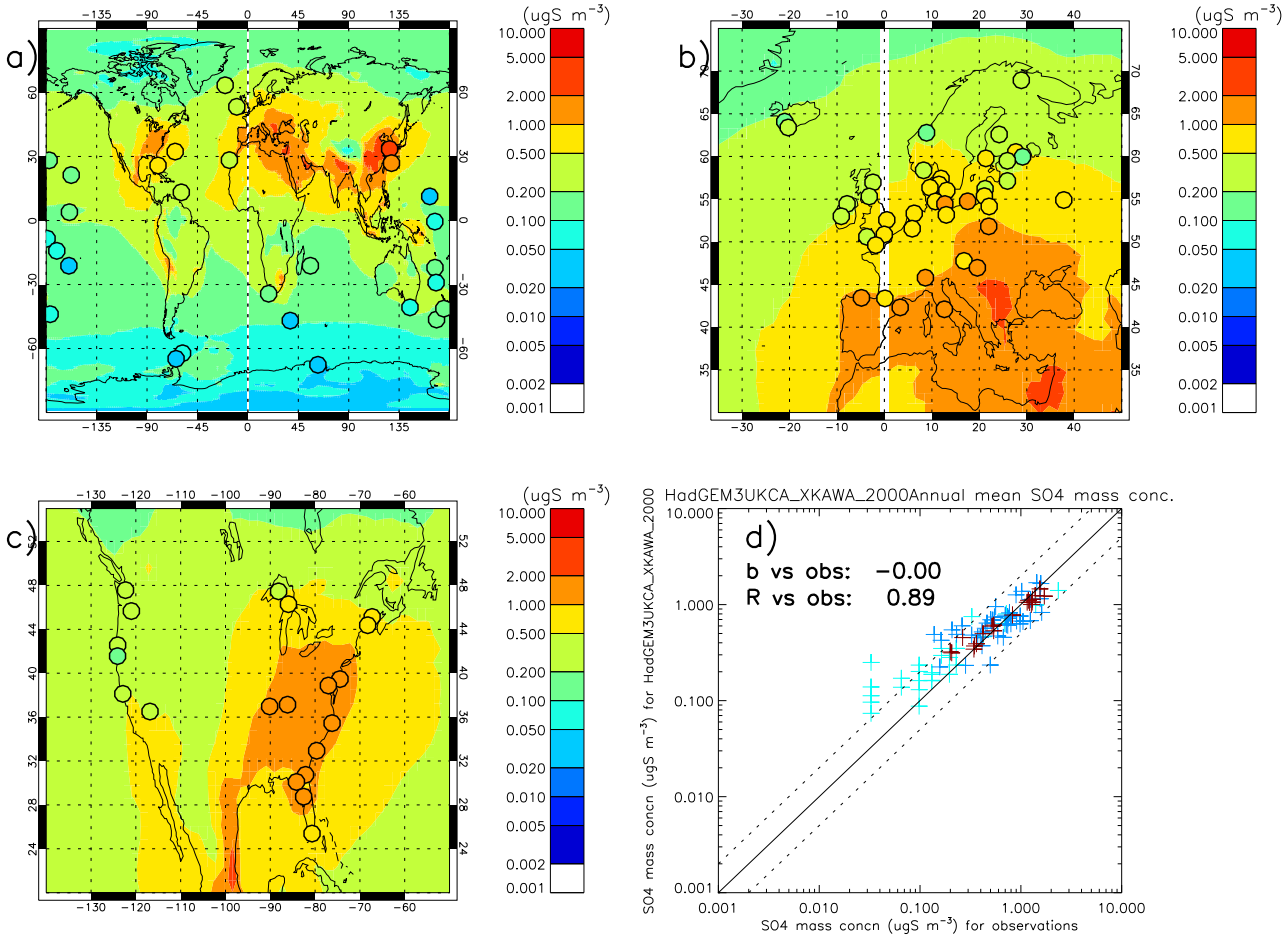


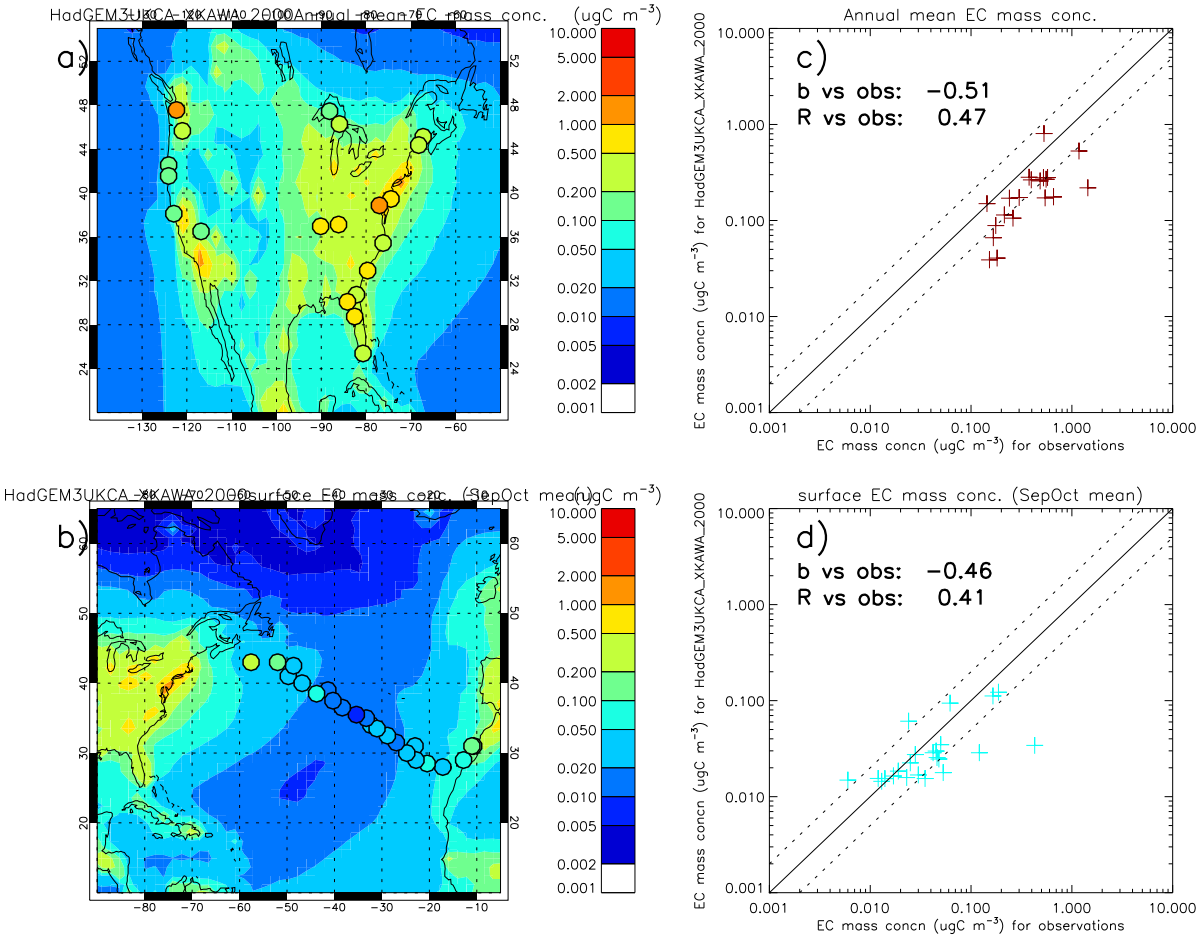
HadGEM3UKCA_XKAWA_2000

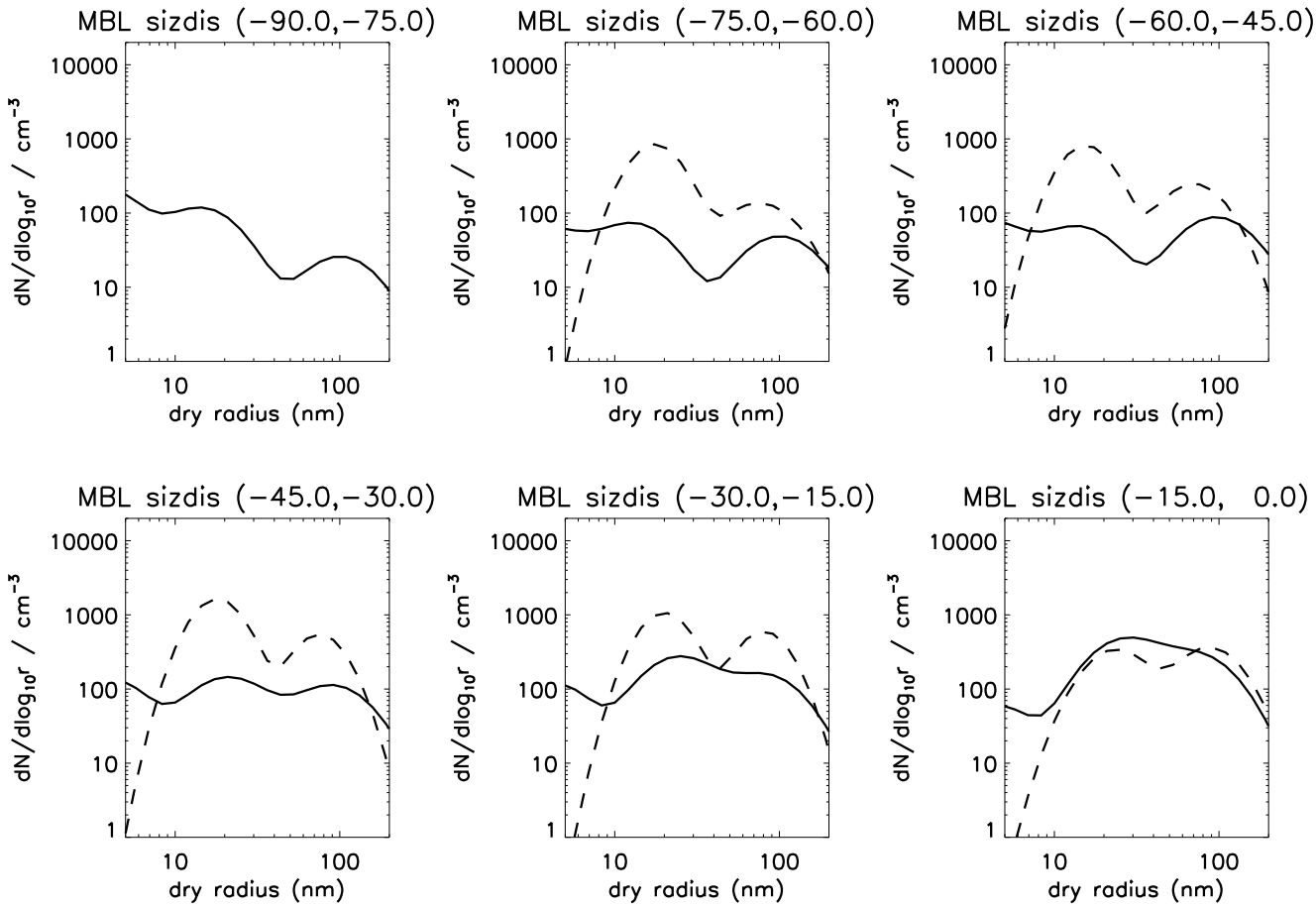


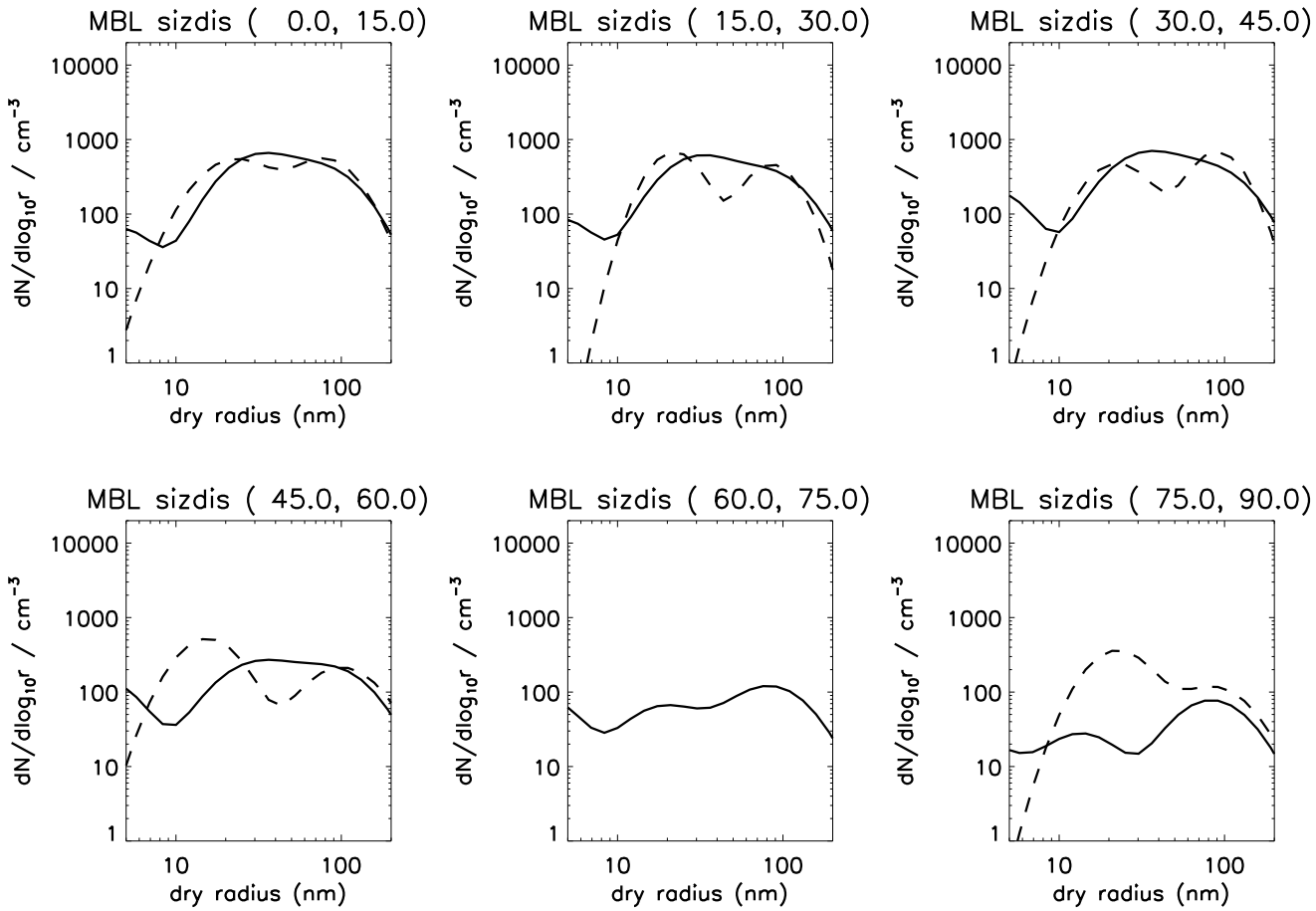
HadGEM3UKCA_XKAWA_2000

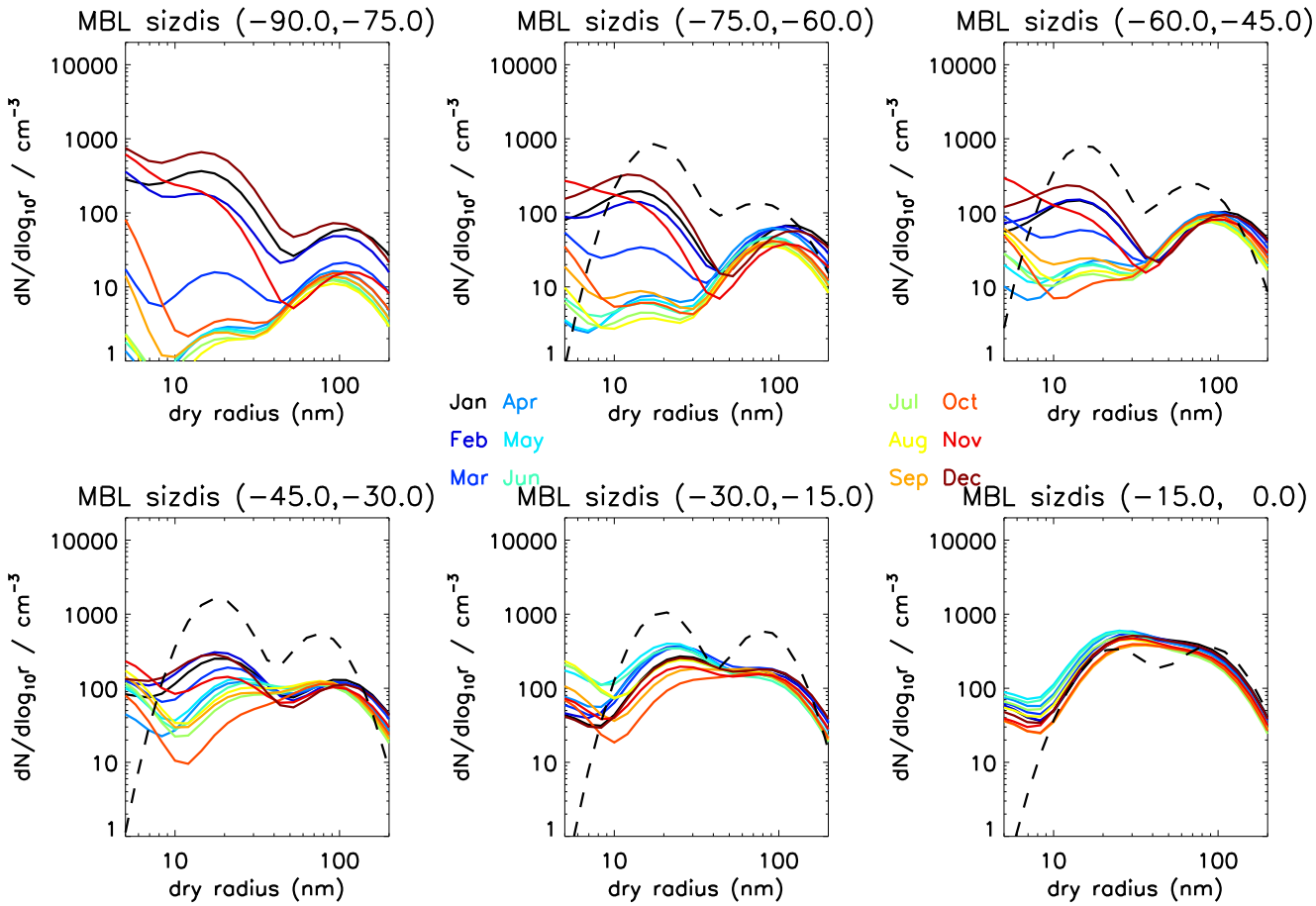


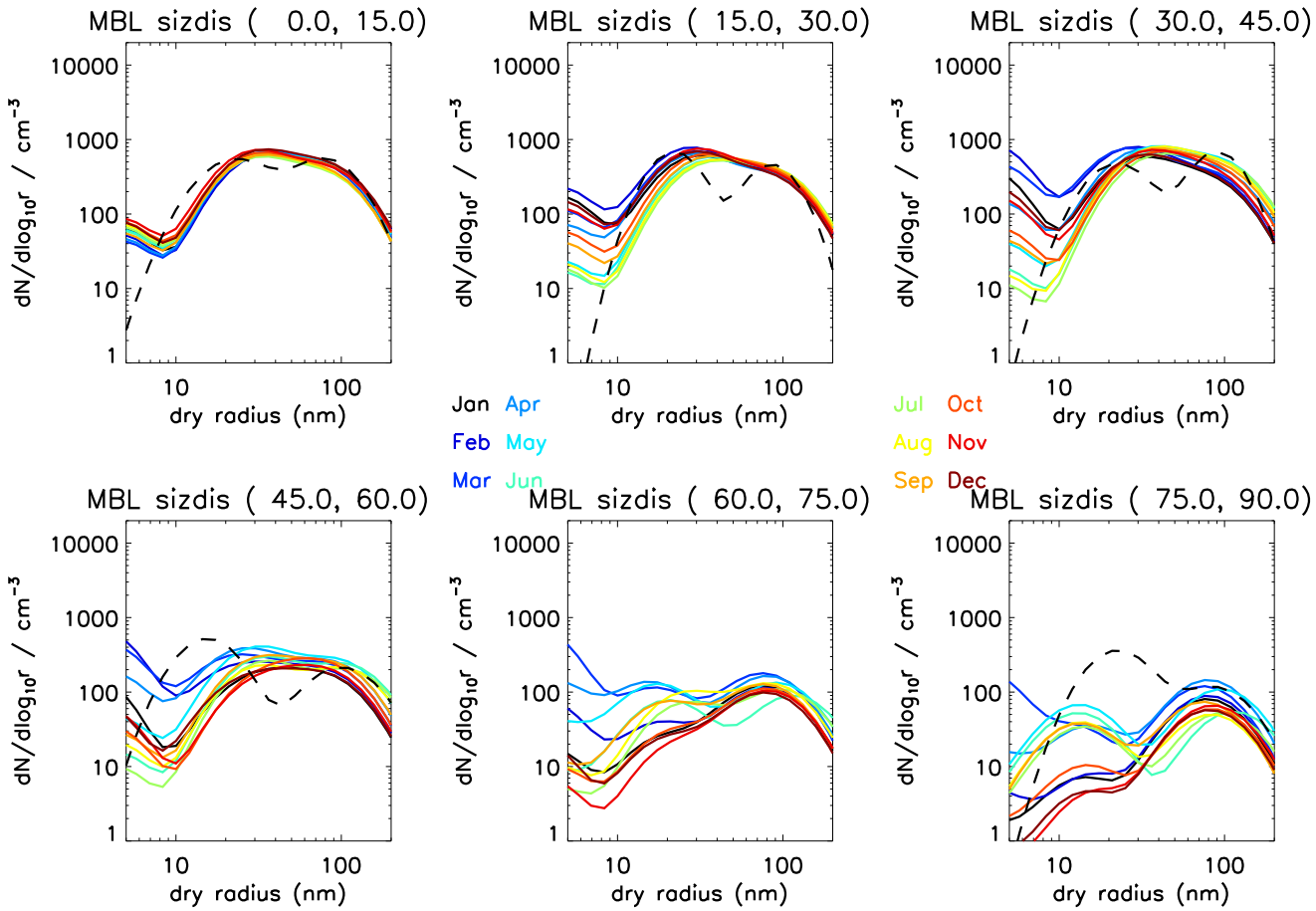

a)
b)
c)
d)
(ugS m$^{-3}$)
10.000
5.000
2.000
1.000
0.500
0.200
0.100
0.050
0.020
0.010
0.005
0.002
0.001
HadGEM3UKCA_XKAWA_2000Annual mean SO4 mass conc.
b vs obs: −0.00
R vs obs: 0.89
SO4 mass concn (ugS m$^{-3}$) for HadGEM3UKCA_XKAWA_2000
SO4 mass concn (ugS m$^{-3}$) for observations

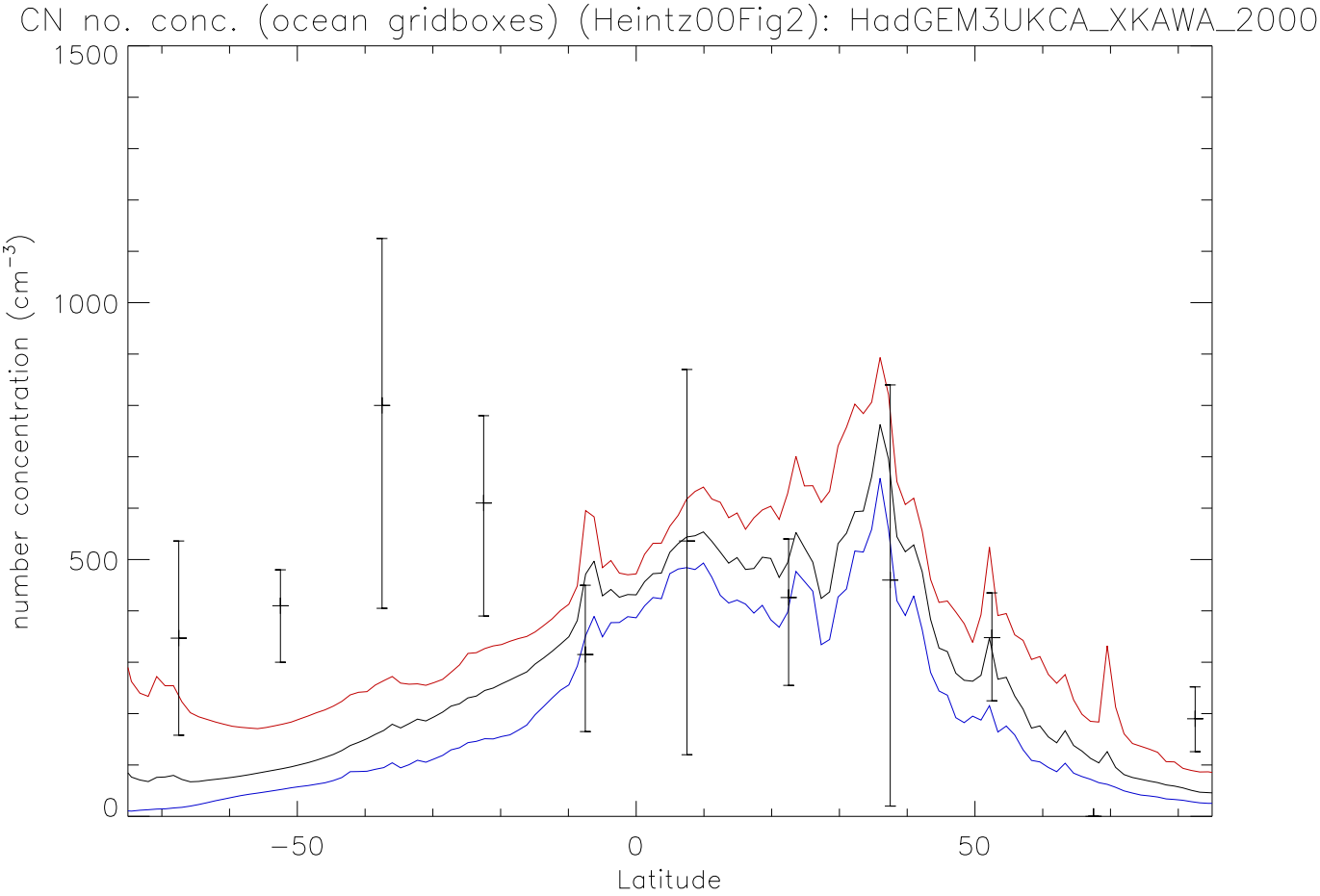

a)
b)
c)
d)
Annual mean EC mass conc.
surface EC mass conc. (SepOct mean)
(ugC m$^{-3}$)
b vs obs: −0.51
R vs obs: 0.47
b vs obs: −0.46
R vs obs: 0.41
EC mass concn (ugC m$^{-3}$) for HadGEM3UKCA_XKAWA_2000
EC mass concn (ugC m$^{-3}$) for observations

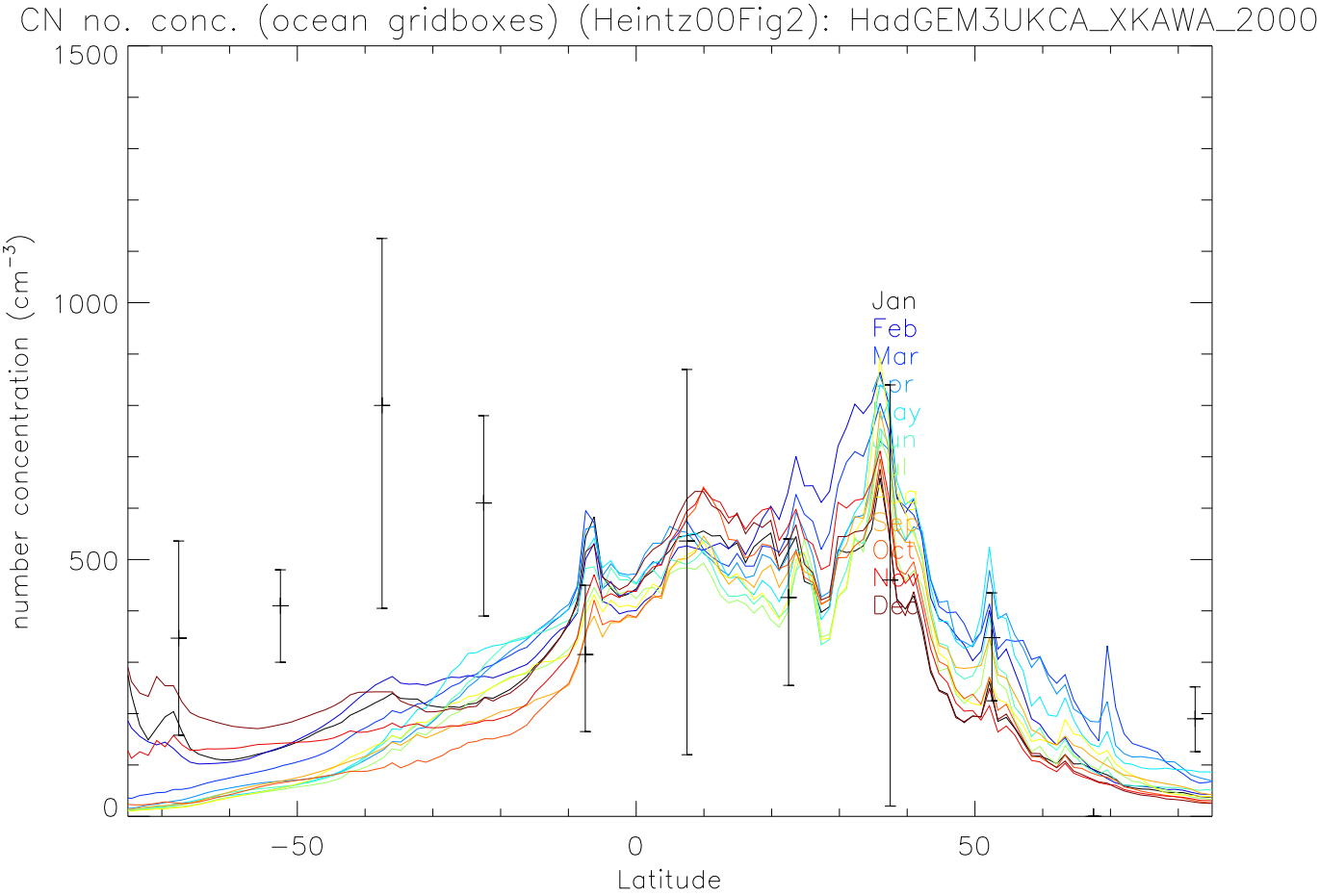

MBL sizdis (−90.0,−75.0)
MBL sizdis (−75.0,−60.0)
MBL sizdis (−60.0,−45.0)
MBL sizdis (−45.0,−30.0)
MBL sizdis (−30.0,−15.0)
MBL sizdis (−15.0, 0.0)
dN/dlog10r / cm−3
dry radius (nm)
10000
1000
100
10
1
10
100

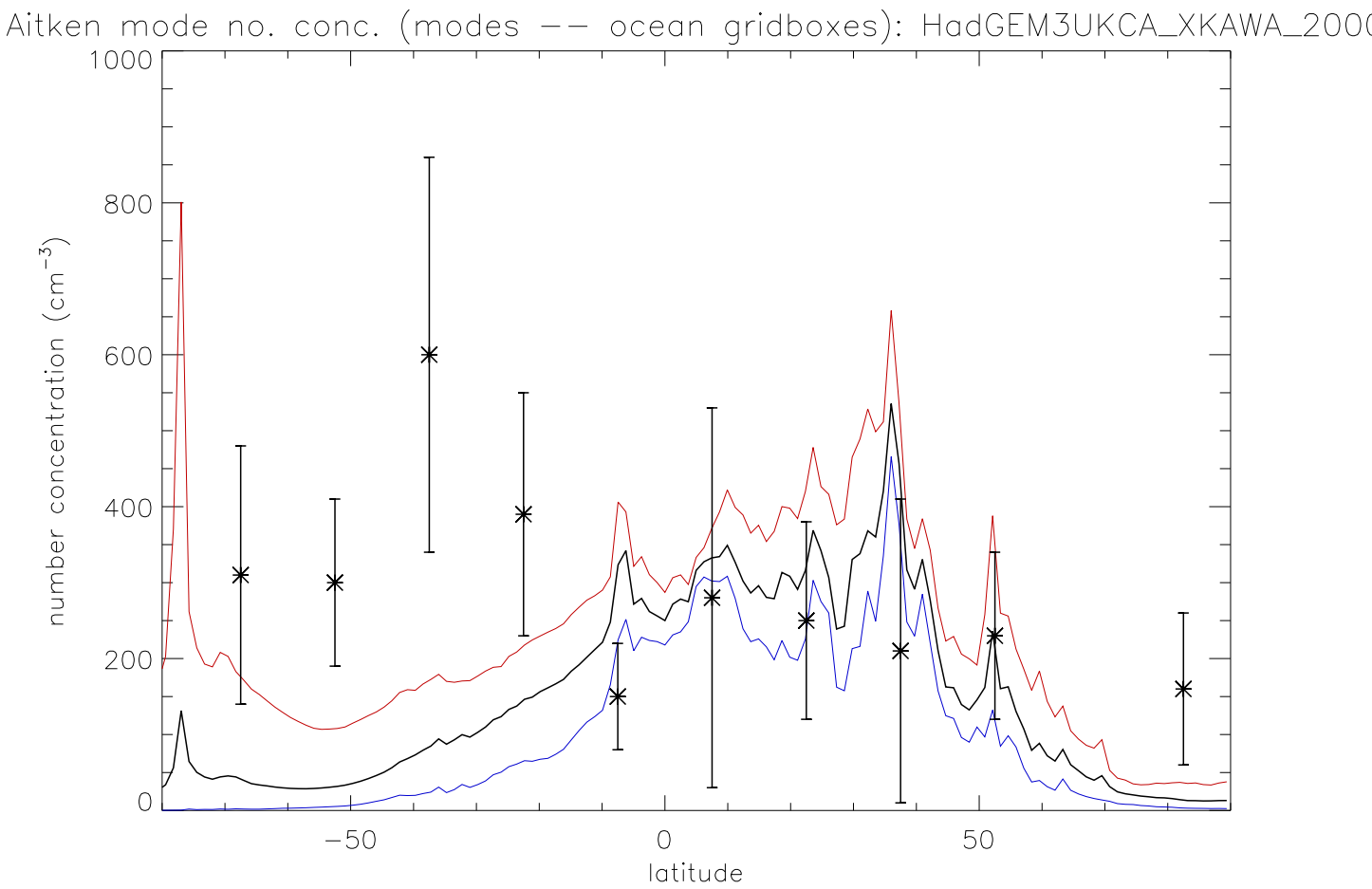

MBL sizdis ( 0.0, 15.0)
MBL sizdis ( 15.0, 30.0)
MBL sizdis ( 30.0, 45.0)
MBL sizdis ( 45.0, 60.0)
MBL sizdis ( 60.0, 75.0)
MBL sizdis ( 75.0, 90.0)
dN/dlog10r / cm-3
dry radius (nm)
10000
1000
100
10
1
10
100

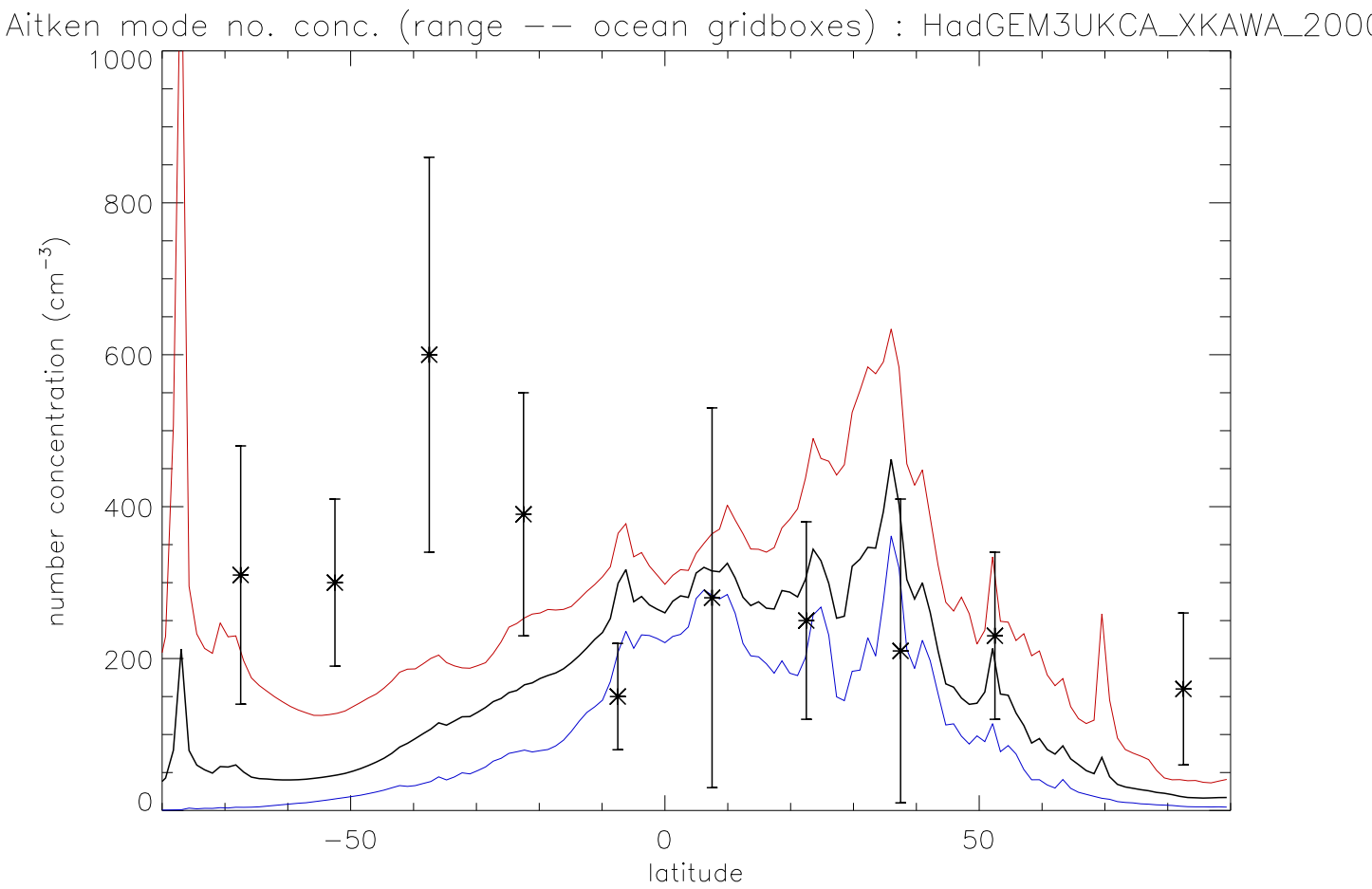

MBL sizdis (−90.0,−75.0)
MBL sizdis (−75.0,−60.0)
MBL sizdis (−60.0,−45.0)
MBL sizdis (−45.0,−30.0)
MBL sizdis (−30.0,−15.0)
MBL sizdis (−15.0, 0.0)
dN/dlog10r / cm−3
dry radius (nm)
10000
1000
100
10
1
10
100
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec

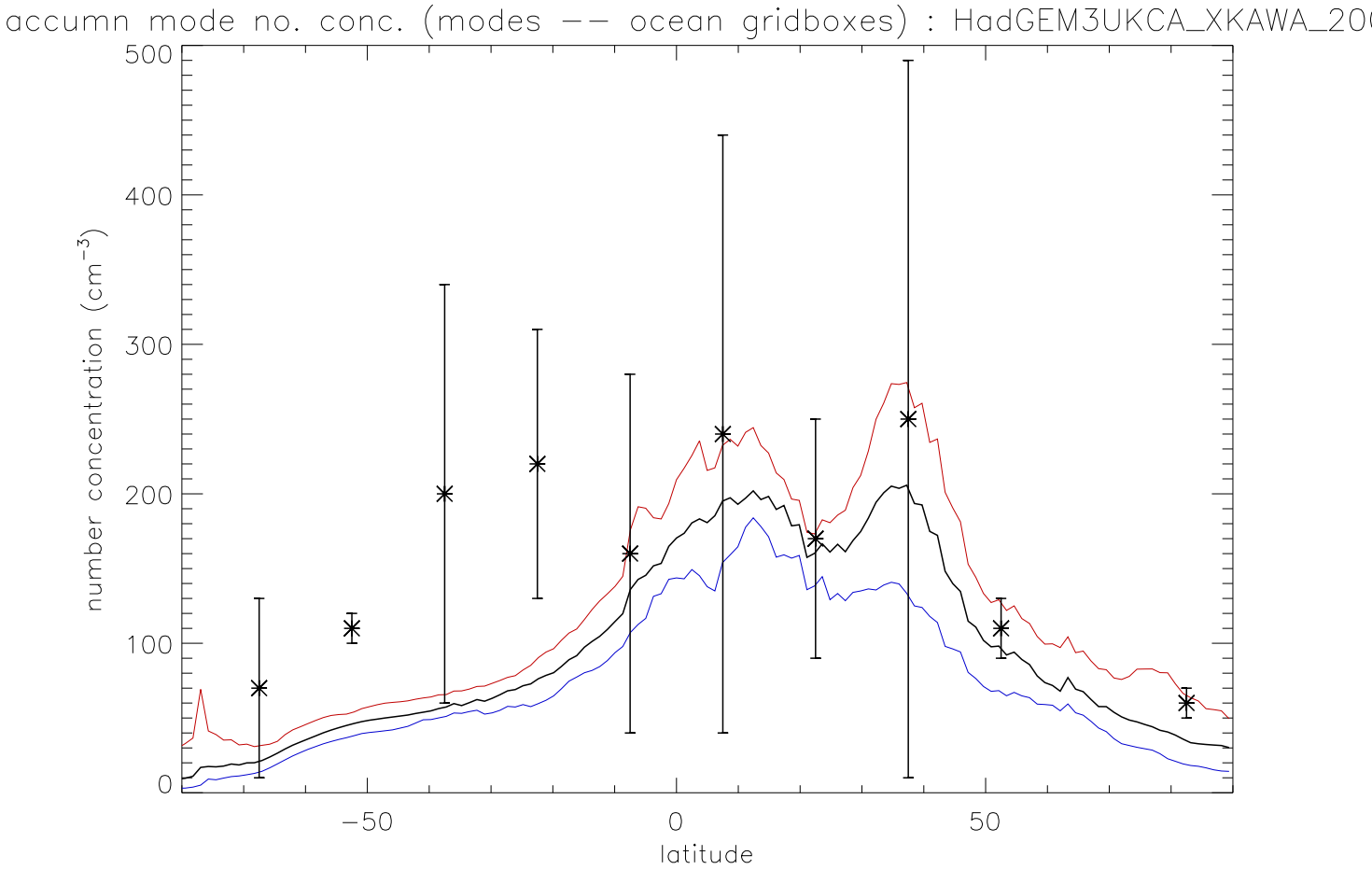

MBL sizdis ( 0.0, 15.0)
MBL sizdis ( 15.0, 30.0)
MBL sizdis ( 30.0, 45.0)
MBL sizdis ( 45.0, 60.0)
MBL sizdis ( 60.0, 75.0)
MBL sizdis ( 75.0, 90.0)
dN/dlog10r / cm-3
dry radius (nm)
10000
1000
100
10
1
10
100
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec

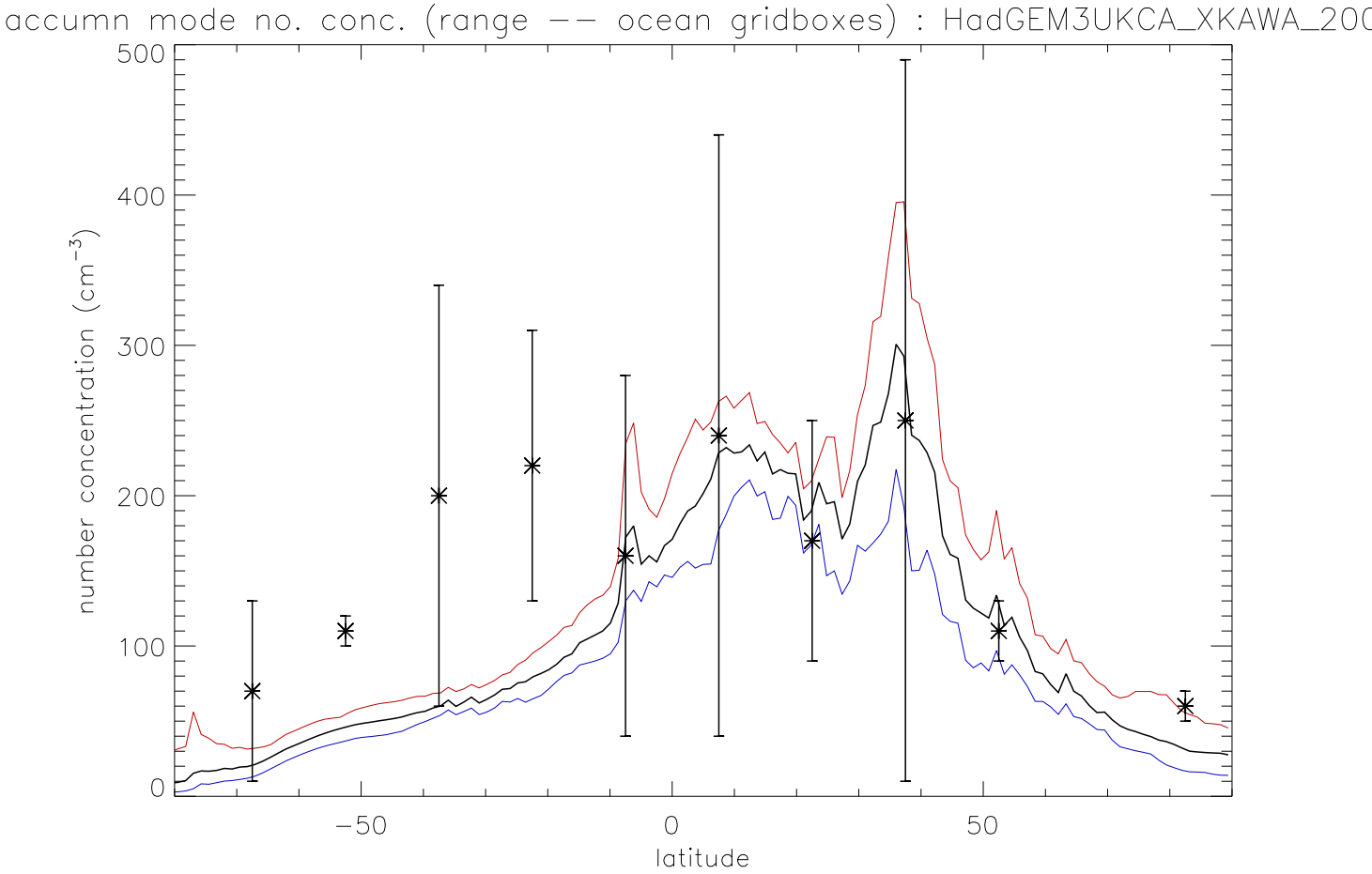

CN no. conc. (ocean gridboxes) (Heintz00Fig2): HadGEM3UKCA_XKAWA_2000
number concentration (cm$^{-3}$)
1500
1000
500
0
−50
0
50
Latitude


CN no. conc. (ocean gridboxes) (Heintz00Fig2): HadGEM3UKCA_XKAWA_2000
number concentration (cm$^{-3}$)
1500
1000
500
0
−50
0
50
Latitude
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec


Aitken mode no. conc. (modes -- ocean gridboxes): HadGEM3UKCA_XKAWA_2000
number concentration (cm$^{-3}$)
1000
800
600
400
200
0
−50
0
50
latitude


Aitken mode no. conc. (range -- ocean gridboxes) : HadGEM3UKCA_XKAWA_2000
number concentration (cm$^{-3}$)
1000
800
600
400
200
0
−50
0
50
latitude


accumn mode no. conc. (modes -- ocean gridboxes) : HadGEM3UKCA_XKAWA_20
number concentration (cm$^{-3}$)
500
400
300
200
100
0
−50
0
50
latitude


accumn mode no. conc. (range -- ocean gridboxes) : HadGEM3UKCA_XKAWA_200
number concentration (cm$^{-3}$)
500
400
300
200
100
0
−50
0
50
latitude